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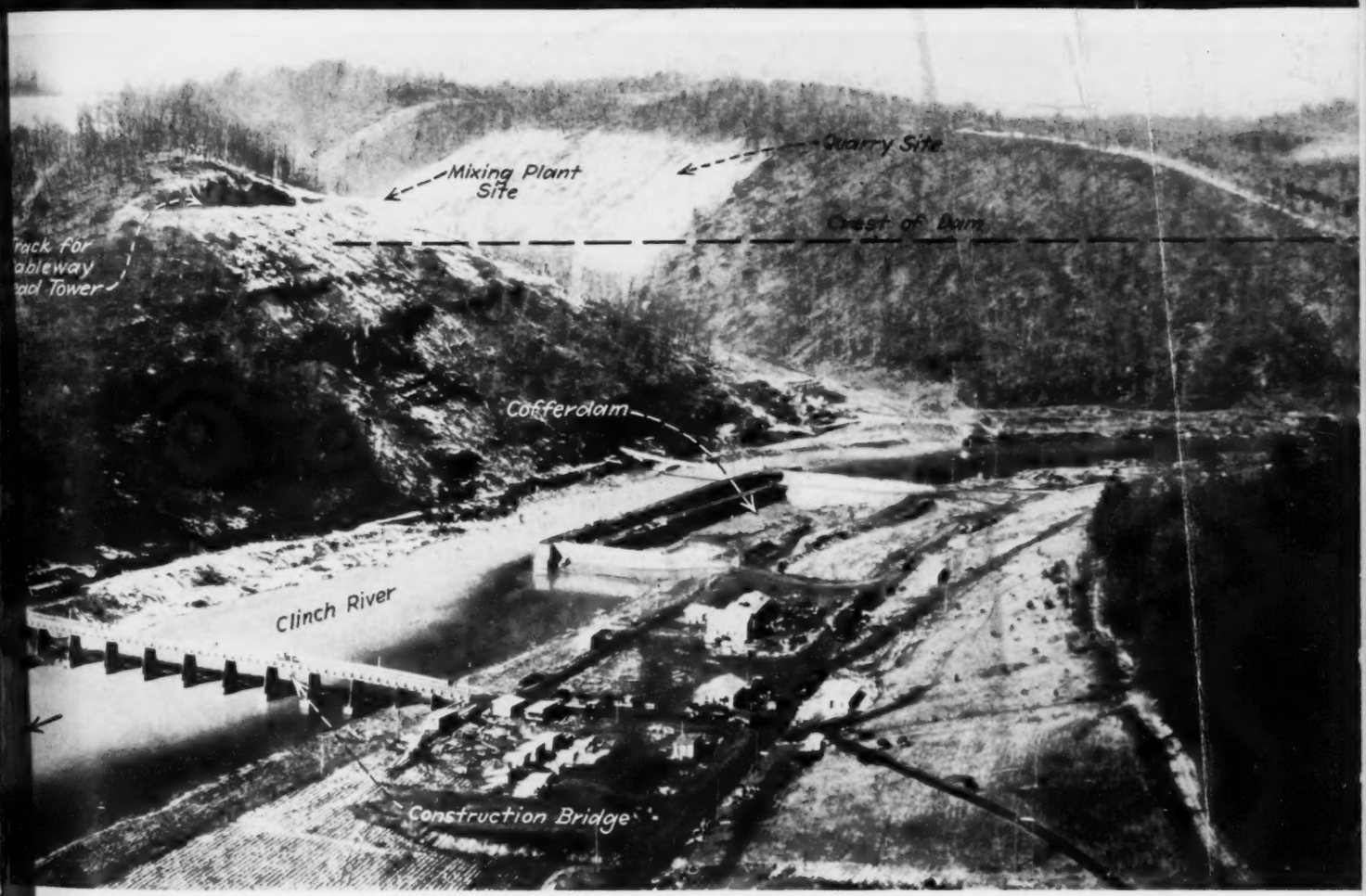
ELECTRICAL WORLD



WHERE NORRIS DAM WILL RISE

● Scene of the second federal power development to be undertaken in the Tennessee Valley. This $34,000,000 project on the Clinch River, to be co-ordinated with Muscle Shoals, will provide a huge electrical output, which must be sold.

● Recent plans announced by T.V.A. and E.H.F.A. looking to the disposal of these coming added resources of power show that this fact is not being overlooked. New appliances and new prices will help develop domestic load. New industries are to be fostered. It all offers a wholesome warning that the New Deal concept of the "Happy Valley" is not to be scoffed aside.

● The electrical industry can well afford to watch and study this program as this new dam grows and the plans unfold.

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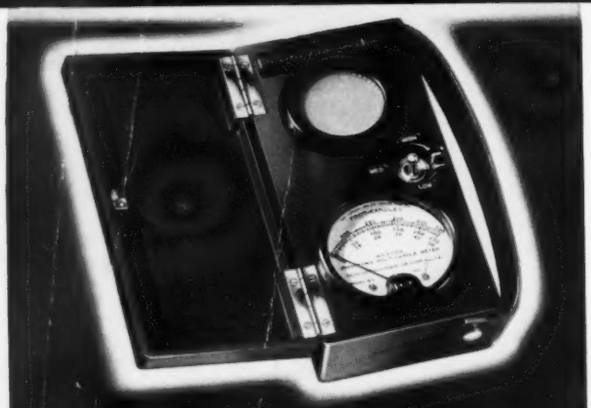
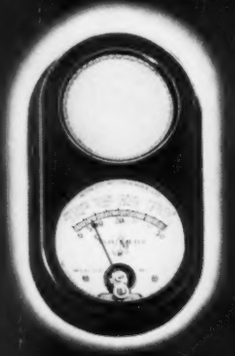
So Easy

TO BE SURE YOUR LIGHT IS RIGHT!



Weston Model 614
— used by time and motion study men — engineering departments — plant superintendents — utilities, etc.



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ELECTRICAL WORLD

A consolidation of Electrical World, Electrical Engineer and American Electrician

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Readers' Guide to This Issue

Of Executive Interest

	Page
Ferguson emphasizes home market	679
Industrial user tests lamps	694
To secure best hydro economies	684
Lightning currents now measurable	688

For Power Company Engineers

How hydro allocations bring economy	684
Cable moved without reeling	690
W. G. Kelley asks about unit equipment	691
Standardization aid to metering	687
How much reactive kva.?	692
To move duct-frozen cable	683
Lightning currents now measurable	688
Postponing pole replacements	681
How strong are connectors?	682
Standard pole tops	680
Better leads aid meter testing	683

On Power Company Sales

Tackle the home market	679
1,200-kva. condenser pays for self	697
In precious-metal melting	696
Power-factor correction	692

For Electrical Engineers in Industry

Large user tests lamps	694
How much reactive kva.?	692
Factory-built assemblies	691
Better meter test leads	683
1,200-kva. condenser pays for self	697
Flexible transformer vaults	697
In precious-metal melting	696

For Electrical Manufacturers

Factory-built assemblies	691
Standardization need in metering	687
Overhead connectors tested	682
How much reactive kva.?	692
Industrial user tests lamps	694
Lightning currents measured	688
Better meter test leads	683

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THIS INDEX is merely a convenient guide. Many articles will appeal to several reader groups—many will apply to all. News and other departments are of general interest.

CONTENTS . . . . . MAY 12, 1934

To Expand Power Sales 679
By SAMUEL FERGUSON, Hartford Electric Light Company

Postponing Pole Replacements . . . 681
By A. E. SILVER, Electric Bond & Share Company

How to Allocate Hydro Loads . . . 684
By Herbert Estrada and John Finlaw, Philadelphia Electric Company

Lightning Currents Measured 688
By H. W. COLLINS, Detroit Edison Company

How Much Reactive Kva.? 692
By EUSTACE C. SOARES, The R. B. Engineering Corporation

Industrial User Tests Lamps 694
By C. C. WILCOX, Studebaker Corporation

City Wiring Inspection Costs 698
By WILLIAM A. HAIG, Chief Electrical Inspector, Milwaukee

Standard Pole Tops	680
Power Company Engineering Practice	682
Standardization Would Aid Meter Jewel Maintenance	687
Electrical Practice in Industry	696
Water Heater Customers Earn 45% Household Rate Cut	700
Letter to the Editor	701
News of the Week	702
Men of the Industry	710
New Equipment	711

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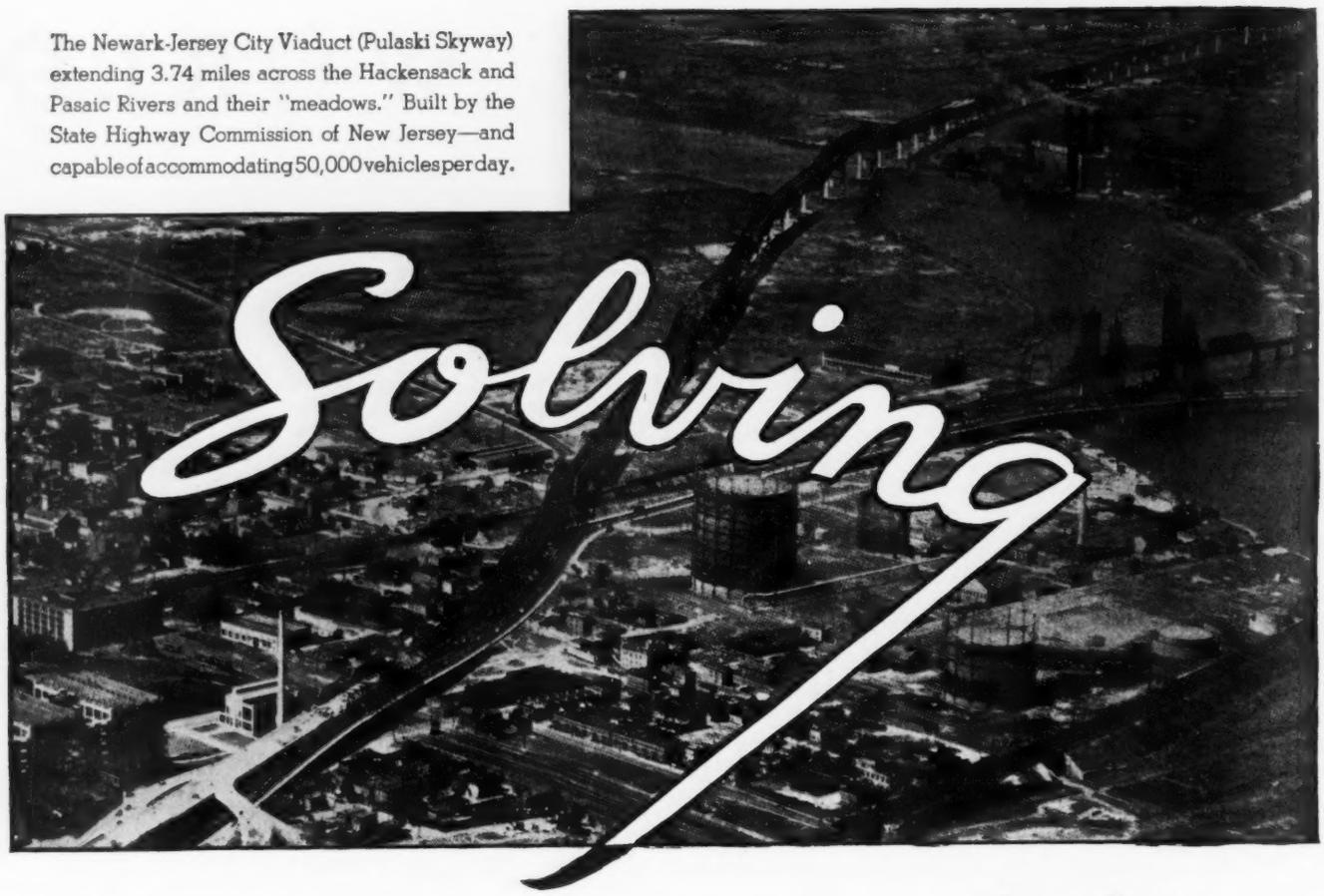
The Newark-Jersey City Viaduct (Pulaski Skyway) extending 3.74 miles across the Hackensack and Pasaic Rivers and their "meadows." Built by the State Highway Commission of New Jersey—and capable of accommodating 50,000 vehicles per day.



DIFFICULT *series lighting* CABLE PROBLEMS

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ELECTRICAL WORLD

Established 1874—McGraw-Hill Publishing Company, Inc.

for the Week Ending

May 12, 1934

L. W. W. MORROW, *Editor*

What's Now Needed in the "New Deal"

After a day spent in favorable testimony and a day of criticism, the leaders of business have sounded a warning, but stand by the NRA. The United States Chamber of Commerce, in convention in Washington last week, reflected the sentiment of the country. There were enthusiasts and ultra-conservatives. But the predominant opinion was that the recovery program has brought definite benefits and should be supported

A canvass of electrical men would probably bring the same result. They would not all think alike. Yet out of the haze and uncertainty of the New Deal certain issues begin to appear.

First and foremost, the Administration should make a distinction between recovery and reform. Recovery should come first and reform movements that retard or threaten recovery should be suspended. Second, an end should be made of legislation that would over-regulate or destroy personal initiative, and of propaganda that paints the manufacturer, banker and business man as reactionary and oppressive persons just because a few of the number have gone astray. And, third, the government should cease tinkering with the currency. The history of inflation is too well known to be disregarded and recovery will be slow as long as the fear of unstable money clouds the industrial horizon.

Lastly, it becomes increasingly clear that part of the NRA program must be revised. Granting that it contains many good features, it has become apparent that it tends to raise industrial prices faster than purchasing power can be created. Furthermore, it is obvious that some of the NRA regulations cannot be enforced any more successfully than prohibition. Therefore, careful and prompt consideration should be given to the revision of all unworkable features of this act.

Few men would vote to return to the conditions of the first of last year. They believe that the recovery program, in which the leaders of industry and business have played so large a part, is driving in the right direction. But they agree with the chamber. They want an end to further restrictive legislation and prompt adjustments, as the process of trial and error shows them to be in the public interest.

Two Paths to Home Loads

It is recognized today that domestic load is the backlog of the power business. The depression proved that. Everybody realizes now that the most important present problem is to build up residence consumption. But many companies have not yet faced the fact that there are two things to be done.

More than half of all consumers now using electricity in this country are carried at a loss. Their monthly bills are too small to pay the cost of serving them. This has been so for years. But it need not continue, at least in this proportion. For a considerable percentage of these loss-customers can be made profitable by developing a relatively small increase in their use of the service. It is a problem quite separate and distinct from the more appealing consideration of larger load building with major appliances.

It is not a question of which job is the more important. One offers a small profit for a large number of consumers that now produce no

earnings. The other offers a large profit from a relatively small class of homes. Both will naturally improve earnings. Both are important. Both jobs can be done now. They can be done at the same time, but not in the same way.

One calls for the merchandising of small appliances and the use of more lighting. The other requires the installation of refrigerators, ranges and water heaters. The two operations are as different as the two types of homes that must be sold. And the test of good management and good marketing among the power companies this year will lie in the combination of the two objectives in a balanced program.

Nema Takes an Important Step

Two reactions have followed the appointment of W. J. Donald as managing director of the National Electrical Manufacturers Association. There is naturally universal regret over the resignation of A. W. Berresford. Then comes the question, Who is Donald? And the answering facts are very reassuring. The second question is, "Can a man who doesn't know the electrical business handle this job?"

Nema occupies a most difficult and important position in the NRA code structure. Its code was one of the first signed. To a considerable degree, Nema has been given the opportunity to demonstrate to the country the capacity of modern industry for self-government.

Right now Nema is beset by the kind of problems that bedeviled the first three administrations of our national government. They were trying to weld together thirteen colonies, each with its own separate traditions, jealousies and aspirations. Here it is a case of harmonizing and uniting twenty-one loose-knit groups, comprising more than six hundred independent, product-minded corporations, and developing in them an industry consciousness and an unselfish co-operation. So far it has been a struggle. The reluctance of some of these separate manufacturers to conform to labor standards, to report operating statistics, to sustain sound prices and to accept the sacrifices necessary to obtain co-operative action has greatly hampered progress.

Under Mr. Berresford's direction, a personnel has been assembled, however, and an orderly relation between these many manufacturers has been established. It is no small achievement. But the operation of such a program calls for centralized authority located in the board of directors and delegated by it. Administration and enforcement cannot be left to committees alone. It must be carried out by an efficient staff if anything is to be accomplished. And member executives so far have too often been unwilling to delegate this power.

The job now calls for planning and for management more than electrical background. The electrical manufacturers' code is basically sound. It lays down a set of rules for self-government. And industry self-government is no less practical than the self-government of a city, once the rules are understood and observed. If Mr. Donald can take the place in Nema of the modern professional city manager and organize to apply and operate these rules the program can go forward. It rests with the manufacturers themselves whether or not he will have the opportunity to make this possible.

Wanted—Industrial Data on Electronic Devices

Expectation of a great field of usefulness for electronic devices in industrial control is fully justified. The manufacturers of tubes are devising new uses all the time. Industrial engineers are doing their bit by individual ingenuity. Radio in its infancy got some vigorous boosts from the amateur experimenter. The same can happen with electronic devices for industrial jobs.

But before much can happen the industrial engineer will have to know more than he does now about electron tubes. Tubes in radio are one thing. But the jargon of plate impedance, mutual conductance, etc., has next to no meaning for industrial usage. Not until the tube comes to be viewed as a tool adaptable to circuits where the garden variety of volts, ohms and amperes rule will the tubes move handsomely into control tasks of which they are eminently capable.

The call is for some one to reclassify tubes feasibly on the basis of their usefulness in performing such tasks. Filament requirements, continuous radio ratings, internal characteristics, arbitrary type designations are all subordinate in this field to: How many amperes? how many ohms? how many volts? how many watts? for the external relay circuits. With the potentialities known in such terms tubes would begin to go places industrially.

To Expand Power Sales —Tackle the Home Market

A Vigorous Statement by a Pioneer Utility Executive Given Before the United States Chamber of Commerce

By SAMUEL FERGUSON

President
Hartford Electric Light Company,
Hartford, Conn.

IF THE power market is to be expanded constant lowering of cost, and therefore of price, appeal to me as two of the more important factors which have a bearing on this objective. I do not mean to convey the impression that price is the most important factor in power service, because reliability is far more essential than low price. I am assuming that in the past ten years this factor of reliability has been so thoroughly taken care of in the design and construction of all major systems that further improvement would bring no commensurate increase in business.

The objective of the effort to lower power prices is not to reduce but to increase the power bills of industry, but only by rendering a far greater value of service for each dollar of increased power sales. This requires the co-operative efforts of the power and industrial engineers—the one to suggest the possibilities of new economical uses with each lowering of price, and the other to apply his knowledge of efficient applications to the particular product of the particular industry to which he is attached.

In the constant effort to lower power costs, I shall not touch on the engineering triumphs of the past, or of those in prospect, except to mention, in passing, the great improvement in plant efficiency brought about by high-pressure steam and the mercury boiler, and in system efficiency by the conquest and control of the very high voltages which make interconnections practicable. I shall content myself with touching on two points.

The first concerns the pooling of facilities by non-related companies and their operation at best efficiencies, regardless of ownership. As an illustration, there is the Connecticut Valley Power Exchange, whereby annually there is saved to a few small companies $300,000 to $400,000 in fuel and more than this in fixed charges on otherwise necessary plant investment.

Having just emphasized the need for the companies to make every effort toward the lowering of their costs as essential to the further extension of industrial use of power, I am now going to appear illogical by making the statement that these savings and economies should not at once be applied to the immediate lowering of industrial power prices.

The reason for this apparent inconsistency lies in the fact that during the past fifteen years the loads of the companies have become unbalanced to such an extent that the greatest of all economies, namely, the joint use of facilities for different types of load, is not being employed to the fullest possible extent.

The joint use of facilities has been the major cause of reduced prices for both light and power and exerts its major influence when loads are in balance. When they are out of balance it results in a separate investment for the sole use of the predominant class. This predominant class is at the present time industrial power, and a corresponding domestic usage has not as yet been developed. It is a case of the pendulum having swung too far and efforts should be made to bring the situation again into equilibrium, if the maximum benefits of joint use are to be obtained. Just as much effort should be put on developing the balance now, when domestic use is relatively low, as was devoted to developing power business when the latter was the weak sister.

Mr. Ferguson has earned the right to speak out for the power industry by a long record of leadership. He has blazed new trails in load building, rates, commercial policy and public relations and his efforts have had a remarkable record of success. His admonition is well timed to the recently announced plans to T.V.A. to foster larger industries. It should reorient some thinking within the electrical industry as well as sound a subtle economic warning to others who may lack this background.

It is, however, just as absurd to ask householders to electrify their homes at prices perfectly justified by the smallness of the earnings derived from present limited usage as it was back in the '90s to expect industries to

utilize power at the then existent lighting prices. What was done then for power must be done now for liberal domestic use; namely, to fix prices which will attract and develop a business which is today non-existent, or nearly so, such as cooking, water heating, air conditioning, etc.

Develop the domestic load

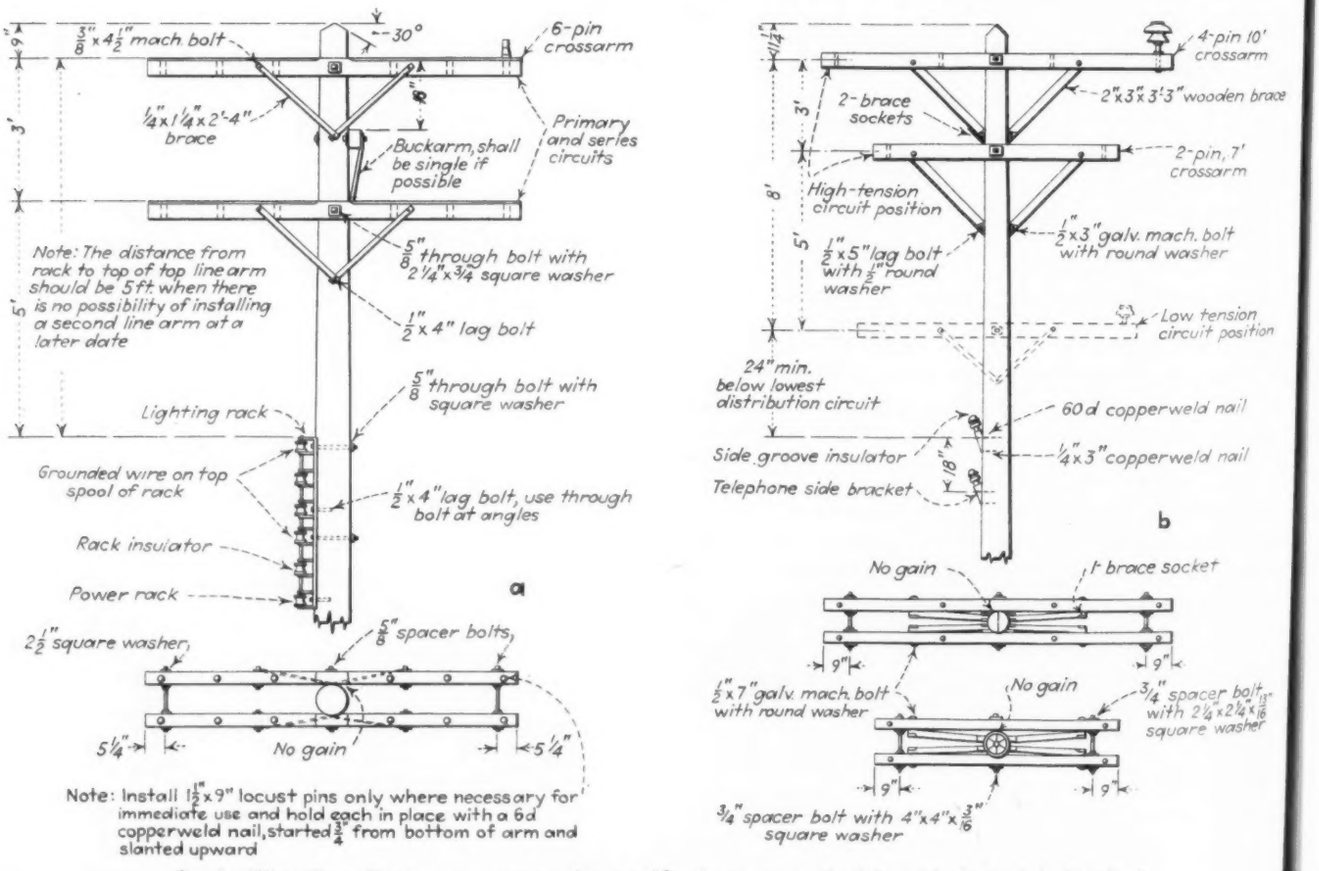
These uses cannot assume major proportions at prices which generally prevail in the domestic field, nor are such prices essential for the profitable operation of such new fields, provided that in lowering prices to attract business which is today non-existent we do not create losses by unduly lowering the prices charged for present uses below the compensatory point for such uses. This means the use of so-called promotional rate schedules which hold present revenues for present usage, but which offer really low prices for the additional potential usage. Price adjustments in this field which will enable the fully electrified home to earn 2 cents or less per kw.-hr. for the entire requirements of light, cooking, refrigeration, hot water, etc., will be doubly effective at the present time due to the desire for such uses which is being created in the public mind by the great Tennessee Valley undertaking, where the fully electrified home is the immediate objective.

In the case of the T.V.A. a slightly different method is employed. Instead of avoiding the losses to be created by rates unduly low for present usage, but necessary for the increased usage, the low rates are made for both uses and the losses thus created are made up for by the addition of a "developmental surcharge" to commercial and industrial business. It is a perfectly good method to use when those other classes can be made to carry the bag but hardly one which can legally be followed by the private companies, which must therefore take the slower course of avoiding the creation of such losses.

In making the necessary rate adjustments, of necessity a certain amount of present revenue must be sacrificed, and it is for the purpose of meeting this loss of revenue that I would conserve the savings derived from plant economies, thus enabling the companies to develop this necessary balancing load faster than would otherwise be possible. It is a field where relatively small sacrifices will produce great results.

In other words, instead of directly and immediately applying the savings from economies to industrial power prices, treat these savings as seed corn too precious for consumption. Plant the seed corn first in the domestic field, and when the fields bring forth, some sixty-fold and some an hundred-fold, then apply the harvest to making a real improvement in industrial prices. This in its turn will produce another harvest, which can then be distributed over all branches of business and serve to promote the well-being of our nation.

Standard Pole Tops


9"
3'
5'
3/8"x4 1/2" mach. bolt
30°
6-pin crossarm
1/4"x1 1/4"x2'-4" brace
Buckarm, shall be single if possible
Primary and series circuits
Note: The distance from rack to top of top line arm should be 5 ft. when there is no possibility of installing a second line arm at a later date
5/8" through bolt with 2 1/4"x3/4 square washer
1/2"x4" lag bolt
5/8" through bolt with square washer
Lighting rack
Grounded wire on top spool of rack
1/2"x4" lag bolt, use through bolt at angles
Rack insulator
Power rack
a
2 1/2" square washer
5/8" spacer bolts
5 1/4"
No gain
5 1/4"
Note: Install 1 1/2"x9" locust pins only where necessary for immediate use and hold each in place with a 6d copperweld nail, started 3/4" from bottom of arm and slanted upward
4 1/4"
3'
8'
5'
4-pin 10' crossarm
2"x3"x3'3" wooden brace
2-brace sockets
2-pin, 7' crossarm
High-tension circuit position
1/2"x3" galv. mach. bolt with round washer
1/2"x5" lag bolt with 1/2" round washer
Low tension circuit position
24" min. below lowest distribution circuit
60 d copperweld nail
Side groove insulator
1/4"x3" copperweld nail
18"
Telephone side bracket
b
No gain
I-brace socket
9"
9"
1/2"x7" galv. mach. bolt with round washer
No gain
3/4" spacer bolt with 2 1/4"x2 1/4"x 13/16" square washer
9"
9"
3/4" spacer bolt with 4"x4"x 3/16" square washer

On the West Penn System two construction specifications are standard for pole tops. (a) Standard pole top for 2,300 to 6,900-volt lines. (b) Standard pole top for 22,000-25,000 and 35,000-volt lines

Stubbing and Periodic Treating Postpone Pole Replacements

Some Facts and Figures on the Prevention and Cure of Wood-Pole Troubles

By A. E. SILVER

Consulting
Electrical Engineer
Electric Bond & Share
Company, New York

Management is now striving to save money rather than to spend it. System policies are under rigorous examination on many properties. Engineers are studying opportunities to prolong the operating life of equipment wherever economically justified. So wood poles come in for their share of critical dollars-and-cents thinking. Mr. Silver reviews some valuable experience data and points the way.

POLES account for from 15 to 50 per cent of the entire investment in the overhead lines portion of the distribution system. There is ample reason for giving as thoughtful attention to the poles during their service lives as is regularly given to their selection and initial preservative treatment when they begin their useful life and to their economical replacement when they end it. In the interim there are needed, in addition to systematic periodic inspection, two definite activities aimed at getting the most out of money spent on poles:

1. Preservative maintenance or decay corrective measures.
2. Mechanical reinforcement to restore strength.

Speaking generally, the stubbing of cedar or chestnut poles should be more economical than replacement and, similarly, decay retardation should cost less than stubbing. Experience has not disproved this premise, although more experience may be necessary fully to prove it.

Ideal preventive maintenance would enable a pole, initially untreated or treated, to hold its strength indefinitely by preventing the initiation of decay of the wood fiber. To date such treatment to avoid infection or maintain preservative virility has been practiced very little. On the contrary, treatment in service has generally been delayed until decay has made substantial progress and some of the pole strength has been lost. None of this pole strength can be regained, except by stubbing.

The Toronto Hydro-Electric System seems to have made the first and best attempt at preventive maintenance. Ten years ago it adopted a pole treatment scheme which has now been described in the January, 1934, *Bulletin* of the Hydro-Electric Power Commission of Ontario by Messrs. Schwenger and Brady of the Toronto system. A concrete collar is cast about the pole at the ground line, with all annual reservoir space filled periodically with creosote and sealed with pitch. They also describe the Williams ground-line, pole-treating units, which consist of a perforated lead pipe spiraled about the pole at the ground line and filled, first every two months and later every two years, with a preservative liquid. There may also be mentioned here the Western Union practice of sterilizing the surface wood by heating and charring and then spraying with creosote oil.

If any of these measures should prove wholly effective in giving poles a "one-hoss shay" quality of equalized life in the ground and at the ground line with that above ground, there would be no further interest in stubbing. This is not, by far, the actual situation today because many poles have already reached an infected and partly weakened state, and for them the question is replacement? or stubbing?

Avoiding refinements, the economics of pole stubbing depend upon three factors:

(a) Cost of stubbing.
(b) Cost of replacement.
(c) Length of remaining life of upper part of pole.

The cost of stubbing must be completely written off by the time pole replacement becomes necessary. Whether stubbing is justified, therefore, can be determined by comparing the total cost of stubbing, plus interest during the remaining life of the pole, with the fixed charges on replacement costs for the same period. However, other factors, such as appearance and a degree of general depreciation through the pole assembly, may have a bearing. The balance of economy, therefore, in normal times, should fall, in a degree varying with the situation, on the side of stubbing clearly to justify it from all standpoints. For this purpose stubbing is handicapped by a cost differential of 15 per cent in the following assumed examples:

Example—Given a normal pole in a residential area carrying several circuits. The company estimates the cost of a conventional wooden stub installed complete to be $8.50, and the cost of replacement to be $30. Assume the remaining life in the upper portion of the pole to be five years. The cost of stubbing with accumulated interest becomes $8.50 + (5 \times 8.50 \times 0.06) = \$11.05$. Taken at 11 per cent (depreciation 5 per cent, interest

6 per cent, with taxes and insurance omitted because applying to the old as well as the new pole) the fixed charges on a replacement pole for the period become $30 \times 0.11 \times 5 = \$16.50$. To justify stubbing the fixed charges on replacement cannot be less than 115 per cent of $11.05, or $12.71. This registers justification for stubbing with a good margin.

The same example, modified for three years and eight years, respectively, remaining life in the upper portions of the pole, gives the following tabulated comparisons:

	Remaining Life in Pole		
	Eight Years	Five Years	Three Years
Cost of stubbing with accumulated interest	$12.58	$11.05	$10.03
Fixed charges on replacement	26.40	16.50	9.90
Stubbing with 15 per cent handicap added	14.47	12.71	11.53
Margin in favor of stubbing	11.93	3.79	—1.63
Saving in immediate cash outlay	21.50	21.50	21.50

Note that the case of three years remaining life indicates that stubbing would not be justified as normal good business.

Being assumed for normal times, the above comparisons may well be modified under stringent financial conditions such as at present. With cash not readily available, the deciding factor may be the postponing of expenditures, even at the penalty of foregoing ultimate savings. Under such conditions, stubbing might readily be advisable for the three years life extension case, or even for two years.

The only present well-established method of stubbing and the one which involves least cost is that using the familiar wooden stub, either with the butt of the old pole left in place or with this butt cut off and pulled out and the old pole hole utilized for setting the stub. The stub may be of treated new timber or cut from a sound used pole and reconditioned. The pole may be held to the stub by through-bolts, wire wrappings or specially designed bands or clamps, or any combination of these.

Examples, estimated from experience, of two Middle Western companies of costs of stubbing by this method follow:

Company A	Using Cuts from Old Poles	Using New 11 Ft. Creosoted Cedar Stubs
Banding wire	0.90	....
2 bolts	0.16	....
2 bands	....	2.46
1 stub	1.00	3.44
Labor	3.50	3.50
Total without overhead	5.56	9.40

Company B	Using Wire Wrapping	Using Hubbard Band
1 stub	$1.00	$1.00
4 3-in square washers	0.20	....
2 ¾-in. machine bolts	0.20	....
Wire and stapler	0.60	....
½ gal. creosote	0.20	0.20
Bands or clamps	....	2.66
Labor and truck	6.00	6.00
Storeroom overhead	0.30	0.50
Liability insurance	0.05	0.05
Total (without office overhead and superintendence)	$8.55	$10.41

The chief disadvantage advanced against wooden stubs is unsightly appearance. Trade metal pole mounts overcome this objection to a large extent, but at considerably higher cost for any now available. However, there is a field for the use of these devices in cases where appearance or space is of primary importance.

One such device is the "Williams" pole mount, which has been on the market for a number of years. A more recent device of good appearance and other promising features is the "Hammel butt socket."

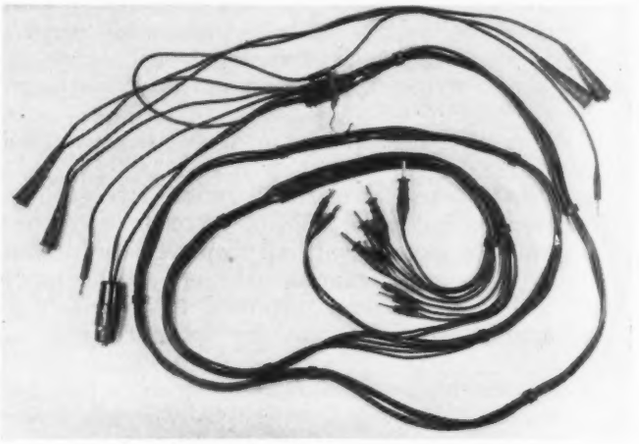
POWER COMPANY

Better Meter Test Leads with Molded Rubber

By H. V. HARDING
Detroit Edison Company, Detroit, Mich.

Difficulties encountered by the meter test man in the performance of his daily work are innumerable. He has to set up standard instruments quickly in dark and often damp corners or work on live apparatus where he is crowded by water pipes, furnace flues and all the odd household furniture, garden tools, etc., which find their way to the basement. He is usually working under high pressure, therefore his equipment should be of the best.

Until the development of the test cord now in use in the Detroit Edison Company, one of the weak spots in his "set-up" was the armful of loose wires and jumpers he had to carry. Often the tape or insulation was frayed out, with the result that burns and flashes were frequent occurrences. Contacts in the load-changing plug would burn or make poor contact and the test would have to be halted to make repairs. Each wire had to be traced out before connecting, which meant lost time and energy. The perfection of the test cord, shown in the illustration, has met all the shortcomings and objections to the old type of test cords and has provided the meter test men of the Detroit Edison Company with a dependable and useful means for a quick and safe set-up.



Solution of the meter test lead problem

This cord is one picked at random from 25 which have been in constant use for many months and yet show no appreciable signs of wear. The high cost of maintenance of the old type of jumpers has been almost entirely eliminated. Occasionally it has been found necessary to replace worn contacts, but as these are a stock item, their cost is low.

The new cord is made as an all-vulcanized job with standard rubber-insulated wire to which the terminals are soldered. Handles of soft rubber, common joint, load-changing plug and binders for the various groups of wires are then vulcanized from a soft but very strong rubber. The illustration shows the common joint, which neatly packs fourteen wires in a very small space; the

load-changing plug, with removable contacts, and the single connecting plugs. The latter have rings molded in for the purpose of quick identification. A hook attached to the load-changing plug is arranged for suspending the unit from nail, water pipe or any other convenient means. An average of sixteen meters per day are tested with these cords, which figure in itself is sufficient proof of the worth of this new development.

What We Found in Testing Overhead Clamp Connectors

By C. C. CORNELIUS
Kansas City Power & Light Company, Kansas City, Mo.

Clamp connectors have been devised in various forms —U-bolt and vise types, wedge clamps, side or parallel groove clamps and wedge connectors—all of which are used on primary or high-voltage work and for low-voltage secondaries and services. The first three types of devices are those most widely used on low-voltage secondary and services and the last three types on primary or high-voltage distribution connections.

The advantage of clamping devices making connections on low-voltage secondary and services is largely in the ease of connecting and disconnecting such services. While the cost of the connector in making the service connection may be more than the cost of a soldered connection, this cost is usually offset by the saving of the routing of a service gang to complete the job. The advantage of clamps for primary connections is to facilitate hot line work and their use is necessary on high-strength conductors where soldering is impossible.

Sufficient initial conductivity is obtained in all the types of service connectors without difficulty. However, there is the problem of getting a design that will be simple, economical and still have the ability of maintaining a tight joint over a period of time under the strains and vibration imposed. The accompanying tables show tests for conductivity and carrying capacity of three different types of service connectors.

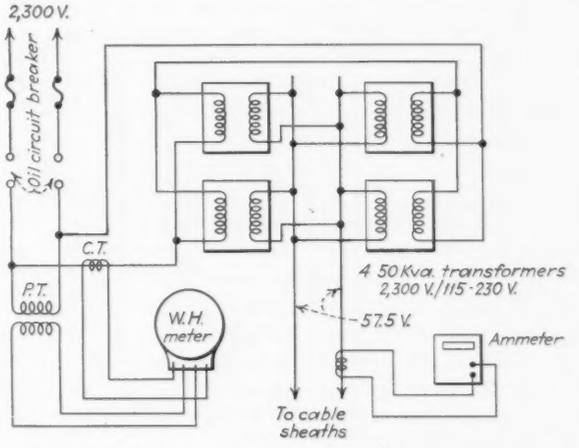
Fusing Test of Conductor and Service Connectors

Manufacturer	Size Conductor	Fusing Current, Wire	Time, Seconds	Fusing Current, Connector	Time, Seconds
A	6	667	60.7	2,500	5.617
B	6	1,200	15.6	2,500	5.7
C	6	2,500	5.55	2,500	6.0
A	4	950	74.28	3,840	5.3
B	4	1,900	15.37	3,840	5.6
C	4	3,840	4.07	3,600	6.3
A	2	1,350	85.75	4,800	7.233
B	2	3,600	7.017	4,800	8.035
C	2	4,800	6.75	4,320	6.7

Connectors were not damaged by fusing the conductors.

Duct-Frozen Cable Thawed Electrically in 2.5 Hours

During the recent severe winter weather a 15-kv., No. 4/0 lead-covered transmission cable on the Boston Edison system developed a fault and had to be removed from an underground duct. The cable had become solidly frozen into the duct and in order to withdraw it electric thawing was undertaken. Describing the process before a group of utility engineers in Boston, H. C. Hamilton,



Series-parallel transformers speeded cable thawing in icy duct

superintendent of the Edison company's standardization and testing department, stated that the work was done by connecting four 50-kva. transformers in series-parallel, supplying energy from a single-phase, 2,300-volt source and delivering 55 volts on the secondary side for thawing. Available curent capacity was 1,700 amp.

The cable section in trouble was about 400 ft. long. A loop was made of this cable with a companion cable in an adjacent duct line and about 300 amp. was applied for one hour, the conductors being the lead sheaths of the cables. The current was then increased to 550 amp. and held for 1½ hours. After one-half hour at 550 amp. the sheath temperature reached 23 deg. C., and remained constant for the rest of the heating period, when the circuit was opened and the cable successfully removed.

Solderless Service Connector Tests

Size Wire	Manufacturer A			Manufacturer B			Manufacturer C		
	No. 6	No. 4	No. 2	No. 6	No. 4	No. 2	No. 6	No. 4	No. 2
Resistance of joint micro-ohms	5.84	13.11	6.56	4.22	1.031	4.67	5.57	3.87	4.52
Inch-pounds torque applied to tighten	35	42	70	35	42	70	35	42	70
Current through joint (amp.)	70	90	125	70	90	125	70	90	125
Time elapsed with current flow (minutes)	90	90	90	90	90	90	90	90	90
Temperature (deg. C.) rise from ambient of 31 deg. C.	13.0	10.5	13.0	11.0	14.0	10.5	10.5	10	12
Temperature rise of wire (deg. C.)	11.0	11.5	12.0	11.0	11.5	12.0	11.0	11.0	11.0

How Loads May Be Allocated

Plan followed in co-ordinating the Conowingo Station with

By HERBERT ESTRADA
and JOHN FINLAW
Philadelphia Electric Company

CONOWINGO hydro station is a run-of-river plant utilizing the full flow of the Susquehanna River for about 70 per cent of the year. During the remaining 30 per cent of the year the river flows are in excess of what can be utilized by the present installed capacity of 252,000 kw. The plant generates approximately 40 per cent of the total energy output of the Philadelphia Electric Company system in a normal hydro year. It is highly important to allocate the load correctly to this station as it has much effect on the economy of the connected steam system.

Production costs of a run-of-river hydro plant do not vary appreciably with energy output. Consequently, the hydro load should be so allocated that the over-all costs of the connected steam stations are reduced to a minimum by application of the following principles:

1. Utilization of the maximum energy available from the river within the limits of plant capacity.

2. Utilization of this energy to obtain maximum hydro loads during the high load periods of the day, and thereby reduce steam station peak and energy costs to a minimum.

Steam base load

Minimum steam station costs are closely approximated by allocating to Conowingo a block of the system daily load of such proportions that the area of the block corresponds to the available energy to be generated from the water to be used on the particular day, and the ordinate of the block corresponds to the hydro plant capacity.

Referring to Fig. 1, the higher the position of shaded area, representing the block of load allocated to Conowingo, the less will be the area of this block. The area of the block is proportional to the Conowingo energy output. Hence, the lower load limit of the shaded area, indicated as steam base load, increases as the energy output from Conowingo decreases. The steam base load may be defined as that system load above which Conowingo becomes the marginal station in system loading, taking all the variations in system load within the limits of its capacity. When the system load exceeds the steam base load plus the capacity of Conowingo the excess must be carried as steam peak. The steam stations then take the variations in system load. The steam base load then determines the proper loading of Conowingo. When the system load is less than the steam base load it is entirely carried by steam and Conowingo is shut down. When the system load exceeds the steam base load, but is less than the steam base load plus the capacity of Conowingo, the steam stations continue to generate the steam base

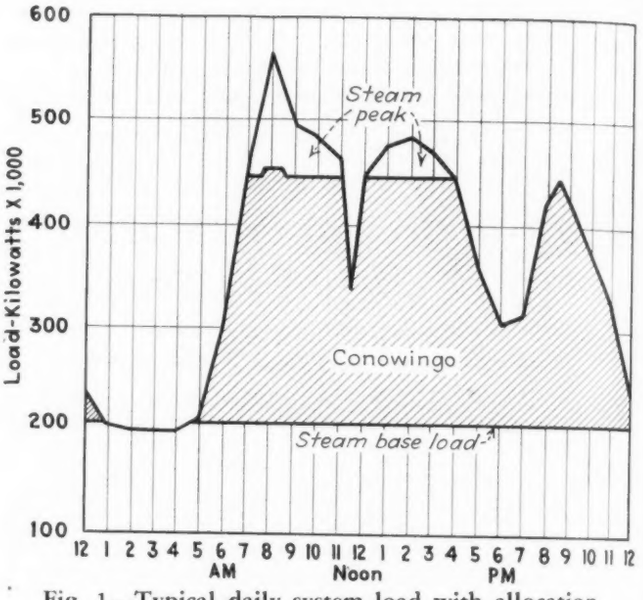


Fig. 1—Typical daily system load with allocation of hydro load

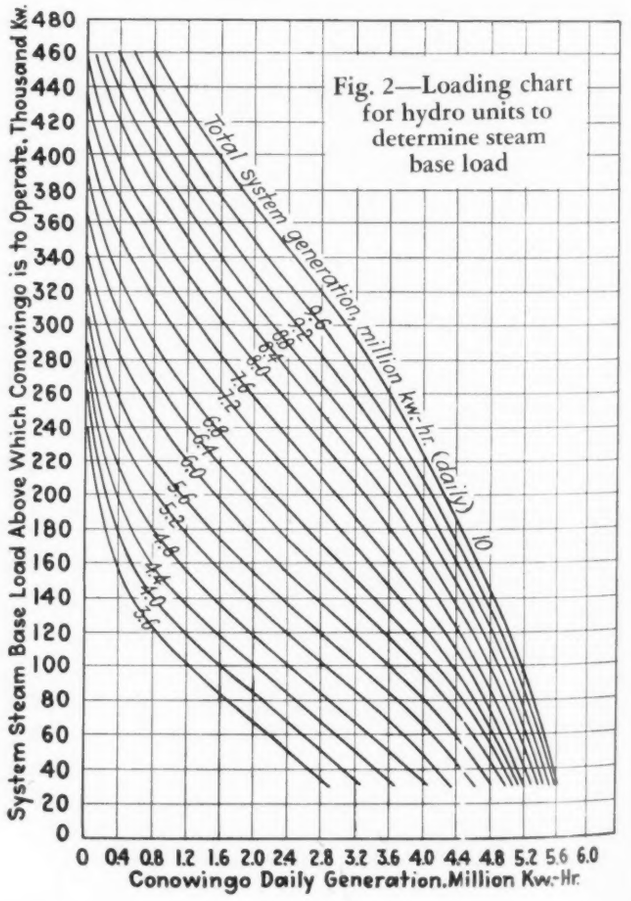

System Steam Base Load Above Which Conowingo is to Operate, Thousand Kw.
Total System generation, million kw.-hr. (daily)
Conowingo Daily Generation, Million Kw.-Hr.
0 0.4 0.8 1.2 1.6 2.0 2.4 2.8 3.2 3.6 4.0 4.4 4.8 5.2 5.6 6.0

Fig. 2—Loading chart for hydro units to determine steam base load

for Best Station Economies

the Philadelphia Electric and connected systems

load, while Conowingo is increased or decreased in accordance with the variations in system load. When the system load exceeds the steam base load plus Conowingo capacity the loading of Conowingo remains at its capacity and further system load variations are allocated to steam.

At times of low river flow and correspondingly low Conowingo energy output the steam base load will be quite high and Conowingo will operate on peak. When the river flow is greater than the maximum usable flow the steam base load will be reduced to a minimum. Corresponding to each value of Conowingo daily kilowatt-hour generation there is a definite steam base load for a particular day. This relation is utilized in determining the steam base load for each day by using the Conowingo loading chart for seven machines available at Conowingo. These curves determine the steam base load for a given daily Conowingo energy output and daily system generation. Similar charts are used if less than seven machines are available at Conowingo, one chart for each Conowingo capacity value. The curves are worked out from daily occurrence curves which show the generation in the load curve below each value of system load. The steam base curves apply to the different seasons equally well in spite of the seasonal variations in the shapes of the daily load curve. By using the steam base load as the basis for loading Conowingo, advantage is taken of the Conowingo Pond in absorbing the variations which occur in system daily outputs due to weather conditions and other factors affecting system load.

During certain periods the river flow is such that Conowingo has all its machines economically loaded during the heavy load period of the day and is partially loaded or shut down at night; that is, semi-base load operation. During these periods it may be economical to utilize the hydro capacity beyond the most efficient rating of the units. The hydro station increment rate should be checked against the steam station incremental costs in order economically to justify the utilization of this hydro capacity.

The principles of most economical hydro allocations can be summarized more generally as the utilization of the river flow so as to displace the maximum steam station cost per c.f.s. of river flow. The value of a small increment of river flow c.f.s. is equal to the value of the corresponding small increment of hydro load Δ kw. in displacing steam generation.

The value of the river flow per c.f.s. per hour $= \frac{I}{W}$

Where $W = \frac{\Delta \text{ c.f.s.}}{\Delta \text{ kw.}} =$ hydro station increment rate.

In order to load the hydro station in the overload region beyond most economical capacity the value of $\frac{I}{W}$ must be equal to or higher than during the steam base period of the day, as the total flow for the day is fixed and whatever extra water is used during one period must be stored in the pond during some other period. Therefore, the hydro station is loaded incrementally beyond its most efficient rating in conjunction with the system to carry the steam peak portion of the load curve indicated above the Conowingo shaded area in Fig. 1. In any case, however, the overload capacity of the hydro station, beyond most economical capacity, should be utilized as reserve on the system in order to reduce steam standby costs.

On a well-interconnected system steam and hydro plants must be loaded with regard for the securing of maximum economies. Analysis must be made of the characteristics of generating and load elements. This problem is present on every system and the interchange of experience with other operations is the best guide to its solution. This discussion* of the experience of this famous run-of-river plant on the Susquehanna is therefore of outstanding interest to power company executives and engineers.

The incremental value of the hydro station in this region to be compared to the incremental cost of the steam is $I_B \frac{W}{W_B}$.

Where I_B is the steam base increment cost.
W is the hydro station increment rate.
W_B is the average station increment rate.

If W_B is taken as the average hydro increment rate up to the economical capacity the accompanying curves then give the values of $\frac{W}{W_B}$ in per cent for the overload capacity.

Drawdown in anticipation of increased river flows

Increases in river flow resulting in spillage of excess water over the dam are usually predictable several days in advance from the rainfall data for the watershed as well as from the flow of the tributaries feeding the main stream. Even before this advance information on potential increases in river flow are obtained from the weather maps. If a fairly good assurance is obtained from such data as an increase in river flow which will ultimately result in spillage, it will usually pay good dividends to increase the station draft in anticipation of increased river flow by drawing down on the water storage in the pond. The pond storage is later replaced with excess river flow which would otherwise have been spilled.

**Based upon paper presented to hydraulic power committee, Pennsylvania Electric Association, April 25, 1934.*

The actual drawdown should not be started too far in advance of the actual spillage of water as certain losses resulting from reduced head may overbalance the gain from too early drawdown. At Conowingo it does not pay to start drawing down more than eight days in advance of actual spill.

Application of hydro to system load

The load scheduler, having consulted the weather maps and available load records, estimates the daily kilowatt-hour demand of the system for the succeeding week, and by the use of the developed curves allocates the estimated daily hydro energy available and arrives at a required daily steam base. When required, the hydro energy is adjusted from one day to another within the allowable limitations, to permit scheduling of a uniform steam base for the week, with the attendant minimum operation of boilers and units. For example, if the steam base called for the operation of a generator to carry 5,000 to 10,000 kw., the hydro schedule would be adjusted to permit holding this generator and boiler off, provided this equipment was not needed for system reserve. The load scheduler daily checks and estimates the kilowatt-hour demand for the succeeding day, and when necessary corrects the schedule to prevent penalizing either steam or hydro, but at all times arranges the schedule for over-all system economy.

In arranging the load and reserve schedule full advantage is taken of the hydro capacity above efficient gate openings for peak load and reserve capacity, as this permits a corresponding reduction in operating steam capacity. Likewise, for a quick reserve during certain periods, hydro units are held with the butterfly valves open, as units can be placed on the line in approximately one minute under this condition.

In loading the hydro units the block loading method is followed, as near as practicable to attain as high an efficiency as possible on the hydro station. The transmission line stability places a limitation on the hydro operation during lightning storms over or in the vicinity of the transmission lines that must be taken care of under such conditions in order to maintain reliability of service.

Application of hydro to interconnection load

The load scheduler of the company in the interconnected group, controlling the large block of available hydro energy, having determined the required daily steam base necessary with the available daily hydro energy, supplies this information to the interconnection supervisor, along with the system peak load and capacity estimates for the three periods of the day, namely, 7 a.m. to 12 noon, 12 noon to 5 p.m., 5 p.m. to 12 midnight, and, in addition, an incremental loading cost schedule on the equipment to be operated.

The interconnection supervisor, having received similar data from the other companies of the group, estimates the combined demands of the interconnected group, and by consulting load records determines the shape of the combined group load curve. The available hydro energy is then fitted into the daily curve and a required steam base is found by the application of the same general methods used by the individual company controlling the large block of hydro energy. This steam base is then allocated to the steam stations of the interconnected systems on an economic cost basis. The prepared oper-

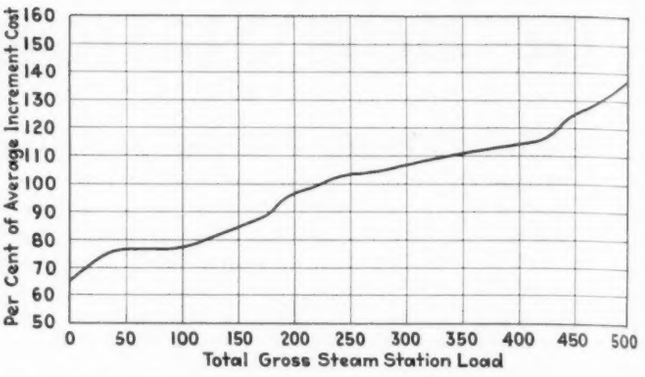
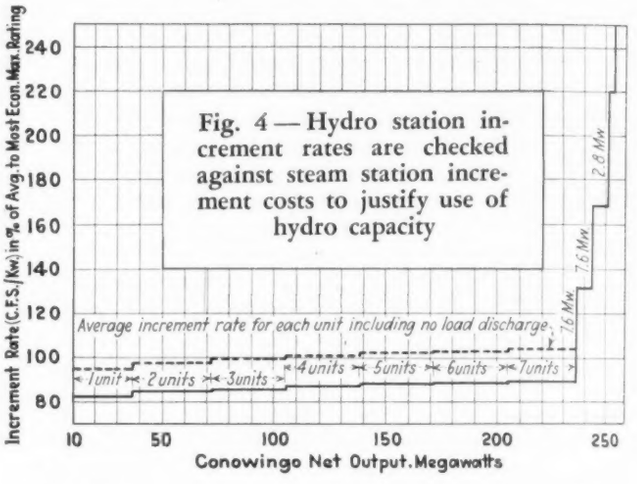


Fig. 3—Per cent of average steam system increment costs to determine hydro loadings



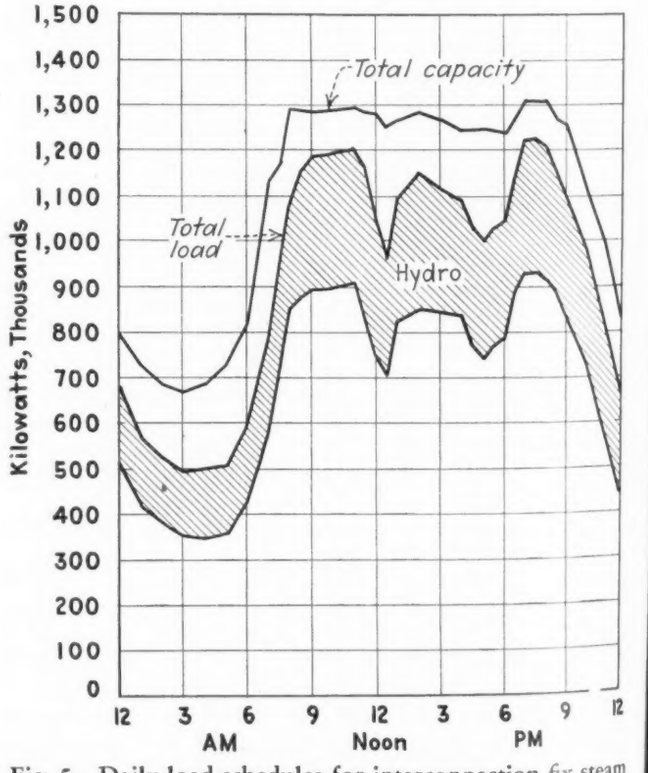


Fig. 5—Daily load schedules for interconnection fix steam base for available hydro energy, allocations of load to companies and the reserve capacity in excess of each company's generation

ating schedule for that day is supplied to the interconnection dispatcher showing the estimated peak loads and allocated capacities of the interconnected systems and, in addition, the dispatchers are supplied data on the incremental steam loadings.

Advantages of the system

This method is used and is effective when hydro is operating up to the limitations imposed by base hydro operation when available energy cannot be economically fitted into the interconnection load curve. Operating the hydro on the interconnected systems' load permits maximum economy on steam by operating boilers and units at maximum efficient loads approximately eighteen to twenty-four hours each day, taking the noon hour and the afternoon drops on hydro. It also permits the steam to be loaded gradually and economically and the rapid increases in the morning and evening to be taken on the hydro units with very little variation in the system frequency.

Standardization Would Aid Meter Jewel Maintenance

By H. H. BROWN
Iowa Electric Light & Power Company, Cedar Rapids

Little uniformity of meter jewel oiling, inspection and cleaning procedures is shown in an analysis of data for eight Middle Western utilities. There also appears to be a need for definition of good and bad jewels in terms of tolerances. Manufacturers and utilities should work this out.

Out of eight companies replying to a questionnaire sent out by the writer for a report to the meter committee of the Missouri Valley Electric Association all lubricate meter jewels except that two do not oil Westinghouse bearings. One company puts a film of oil on the ball or pivot instead of the jewel. All companies except two apply as small an amount of oil as possible. These two either fill or half fill the jewel cup. One of the eight companies oils jewel bearings only when a new jewel or pivot is installed and does not change jewels on periodic tests except when the needle test indicates they are defective. Seven of the eight companies oil jewels on periodic test or install new or inspected jewels that have been oiled.

It seems that the matter of changing meter jewels at the time of the routine test instead of attempting to inspect them on the spot is rapidly gaining popularity. Five of the eight companies report that they change jewels at each test. One company does not and two do not definitely state which procedure they follow, but other data they have furnished indicate that they probably do exchange jewels on periodic tests. This practice was just started by two companies this year and one last year.

Seven of the eight companies are using some kind of microscope for inspecting meter jewels or will begin to do so in 1934. The magnification ratios vary from 8 to 60, with four between 36 and 42.5. Of the seven companies using microscopes only one allows any noticeable defects to pass. The defects allowed in this case consist of not more than three minor scratches, too small to be felt when checked with a sharp needle under the microscope, and then not if they appear in the center of the jewel. A small chip from the edge of the cup would also be passed.

The five companies reporting on the number of jewels rejected by microscope examination give percentages varying from 20 per cent to 55 per cent. It might be interesting to note that the company using the 8-power microscope reported 30 per cent rejection, while one company using a 60-power microscope rejected 33 per cent. The same company that passes a few minor scratches rejects 55 per cent of all jewels which have been in service. This high percentage is probably due to the fact that the meters of this company have had longer service than those on which most of the others had reported.

There are several methods used in cleaning the jewels for inspection. Three companies use a carbon tetrachloride spray, one company uses a chamois skin, one company uses pith and pegwood, and one company applies benzol and polishes with pegwood. There has been some objection raised to the use of carbon tetrachloride because in combination with moisture it will form hydrochloric acid, which will corrode the jewel mounting. This hardly appears to be a practical objection if pure carbon tetrachloride is used because it evaporates so rapidly it would not have time to pick up atmospheric moisture and combine chemically while it remained on the jewel mounting.

Evidently new jewels need inspection

Apparently only three companies inspect new jewels and two have no data as to the per cent rejected. The other company has just started this practice and has rejected 250 of 1,800 jewels inspected. The practice will undoubtedly be continued if this ratio of rejections is maintained. None of the companies replying have had enough experience with synthetic jewels to form an opinion concerning the relative advantages of synthetic and natural stones. It appears that no one has been able to show definitely the effect of defective jewels on revenue. The common experience of finding meters slower on light load than on full load, and finding bad jewels causing slow registration at light loads, indicates that some loss results from this cause. The cost of inspecting microscopically was not inquired into in the questionnaire. Since this might be of some interest, I can say that our own experience so far indicates a rate of about 40 pieces per hour under one microscope. The time devoted to cleaning is included, as well as packing and unpacking. This includes both jewels and pivots, but not balls.

From the diversity exhibited in these replies as to oiling, cleaning and inspection of jewels, it would seem that opinion is far from crystallized on what is a good jewel and how it should be maintained for best performance. Because of the extreme specialization of the meter jewel supply business it is hardly probable that suppliers feel particularly moved toward mutual standardization of their products. But there is nothing to prevent the users of meter jewels from setting up specifications on which all could agree and thus obtain a consistent quality in jewels and their performance.

Lightning Currents Measured

Results of a Systematic Study in the Field to Determine What the Lines Must Actually Carry in a Thunderstorm

By H. W. COLLINS
Detroit Edison Company

Many measurements of lightning voltages have been made on various occasions, but this is the first publication of representative field measurements of lightning currents. With a simple device developed within the organization, Detroit Edison has been investigating both lightning currents and surge current discharges. These findings should be of keen interest to operating engineers and manufacturers of station and line equipment. It should stimulate the making of more such records in other localities this summer.

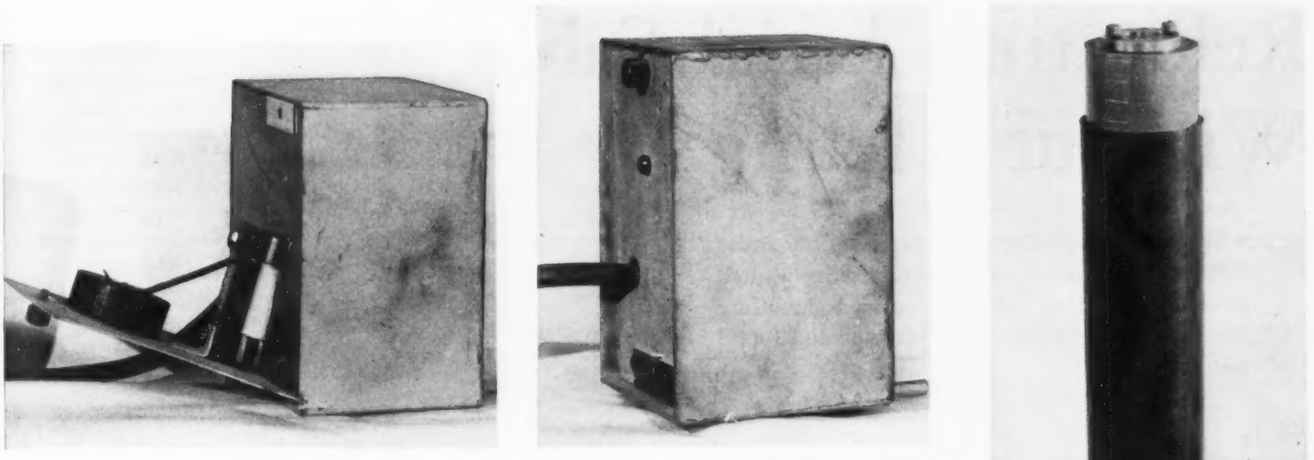
DURING the last few years considerable data have been accumulated in regard to surge voltages that might appear on an overhead transmission system as a result of lightning discharges, but very little has been known concerning the currents that flow in a lightning stroke or must be discharged by a lightning arrester if it is satisfactorily to protect apparatus and service. In order to get some information on this subject, a practical surge current recorder was designed and installed in the common ground lead of the three-phase arrester assemblies used on the 24-kv. wood-pole lines of the Detroit Edison Company system.

The recorder used consists of a gap made up of two 2-in. diameter copper blocks separated by a 1.5-mil short fiber, cotton base, highly hydrated waxed paper, such as is used for the dielectric in ordinary paper condensers. This paper is punctured when a discharge occurs. The gap is shunted by a 500-ohm resistor and the assembly mounted in a metal box about 4x4x6 in., which is connected into the ground lead of the arresters. The resistance is used to shunt any charging current that is present and thus keep the grounded side of the arrester at ground potential.

During the development of this recorder a number of different combinations of gap material and dielectric were tried out and copper and paper were finally adopted because the results obtained were the most consistent of any of the materials tried. The final result is a device which gives a measurement of the maximum current, regardless of the duration of this current. The measurement is obtained by a determination of the size of the hole produced in the paper when it is punctured, due to a discharge through the arrester. Tests with a surge generator and also with 60-cycle current showed that there is relatively small difference in the size of the opening produced by a given peak value of current of a few microseconds duration or one of much longer duration, or several repetitions of this wave, or even with several cycles of 60-cycle current of the same crest value. The tests also indicated that if both small and large currents are impressed on the same paper the indication obtained is that of the larger current only.

The size of the opening in the paper is determined by passing a given volume of air at a given pressure through the opening and measuring the time required for this air to pass through. The device used to check this time consists of two concentric cylinders about 30 in. long and 6 in. diameter, shown in the accompanying illustration. The larger cylinder is closed at the bottom end and is about half full of water. The smaller cylinder slips freely inside of the larger one and is closed at the upper end, except for a circular opening the same diameter as the discharge copper blocks of the recorders. The paper which has been punctured in the gap is placed over this opening and firmly clamped by a ring having the same size opening as the top of the cylinder, thus preventing any air leakage except through any openings produced in the portion of the paper between the copper blocks. The smaller top cylinder with the paper in place is placed inside the larger one, with the open end of the smaller slightly below the water level. The upper cylinder is then released and the time required for it to drop a given distance is determined by a stopwatch. In order to calibrate the device known values of surge current ranging from 50 amp. to 100,000 amp. were produced by a surge generator and passed through one of the recorders, and from these discharges of known current values the corresponding time required for the cylinder to drop was determined and a calibration curve obtained.

The recorders installed in the field were inspected after every storm and all punctured papers were brought into the laboratory and the surge current which produced the puncture was determined by timing them on this device. Obviously, the procedure does not give a true record of the total number of surges through any recorder, but only shows the maximum discharge that has occurred between inspections. With the device installed in the common ground connection for a three-phase arrester set the record obtained is of the total current through all three units, but the distribution between the phases is not known.



Lightning surge investigation equipment

Left—The current-measuring device consists essentially of two copper disks with a paper spacer for puncture. Center—Ready for insertion in grounds and for mounting. Right—Calibration is based upon passing air through the punctured paper and measuring the time and distance on the cylinder calibrating arrangement.

During the 1933 lightning season 499 records were obtained from the recorders installed and the magnitude of the currents was as follows:

Current Amp.	No. of Records	Current Amp.	No. of Records
0	307	5,001	11
501	36	7,501	2
1,001	71	10,000	6
2,001	39	20,000 plus	2
3,001	15		
4,001	10		499

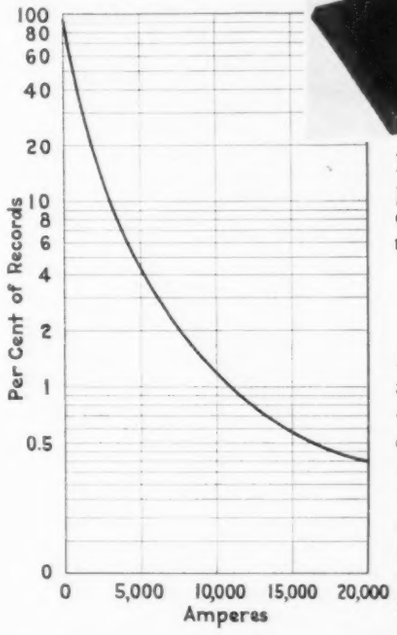
The actual values of the eight above 10,000 amp. are 12,500, 12,500, 14,750, 17,000, 19,000, 20,000, 30,000, 34,000 amp. From these records a curve showing percentage of the total records greater than a given current has been plotted.

The lines from which these records were obtained are all of wood-pole construction, having a flashover at guyed poles of 450 kv. impulse and several times this value for unguyed poles. The airbreak switches and cable potheads have impulse flashovers of about 150 kv.

In order to make any use of these data the complete impulse characteristics of all apparatus on any given system must be known, as well as the voltages that will appear across any given arrester at various values of discharge currents. These values were all obtained from tests made with a surge generator and it was found that the best so-called 80 per cent arresters can be expected to protect for currents up to 10,000 amp. The 80 per cent arrester is the type designed for use on a solidly grounded neutral system and has less voltage drop for a given current discharge than the 100 per cent arrester.

The curve of current values against per cent of total discharges for 1933, which was an average year, shows that about 1 per cent are above this value and should cause flashover if all the current were through one unit only, which probably is not the case.

These data do not necessarily apply generally, but surge current records of this kind obtained over several years' operation should give a fairly accurate picture as to what may be expected as to the average number of discharges for any given installation on the system where the records had been obtained and what percentage of these discharges will be above any given value of current.



Field data showing percent of total records obtained greater than a given current value

Knowing the characteristics of arresters and the flashover of the apparatus protected by these arresters, the engineer can predict with some degree of certainty the number of times any given piece of apparatus should be subjected to surge voltages greater than its flashover during its life, provided the particular installation is no more subject to lightning than the average of the territory over which records were obtained.

Test 220-Kv Oil-Filled Cable

An experimental installation of 220-kv. oil-filled transmission cable is now under test in Italy. Three single-conductor lengths, approximately 220 yd. long, were recently installed by the Società Idrolettrica Piemont between its hydro-electric power station at Cardano and a substation at Cislago. The line transmits between 60 and 70,000 kva. The conductor has a cross-sectional area of 0.20 sq.in. and the inside diameter is 0.43 in. It is insulated by a 0.945-in. casing, the total diameter being 2.61 in. The oil pressure within the cable varies between 11.37 and 24.1 lb. per sq.in. at temperatures varying from —15 deg. C. to +70 deg. C.

Relocating Aerial Cable Without Reeling

An interesting experience in rehabilitation under difficult cold weather conditions. Utility wanted to avoid rereeling because minimum handling means less risk of mechanical damage and found the way.

By I. A. PATTEN

Assistant General Superintendent Electrical Department, Lynn Gas & Electric Company

TO MEET changed conditions resulting from a new bridge development and highway approach at the Pines River, between Lynn and Revere, it recently became necessary to relocate about 1,500 ft. of a 4,500-ft. section of 27-kv. aerial cable tying the Lynn Gas & Electric Company's plant into the Tenney system at Revere. The aerial section is of type H, three-conductor, No. 00 paper-insulated and lead-covered cable weighing about 15 lb. per foot. The relocation plan involves a temporary open wire pole line across a marsh traversed by the highway to clear the roadway during the bridge construction period. When the state notified

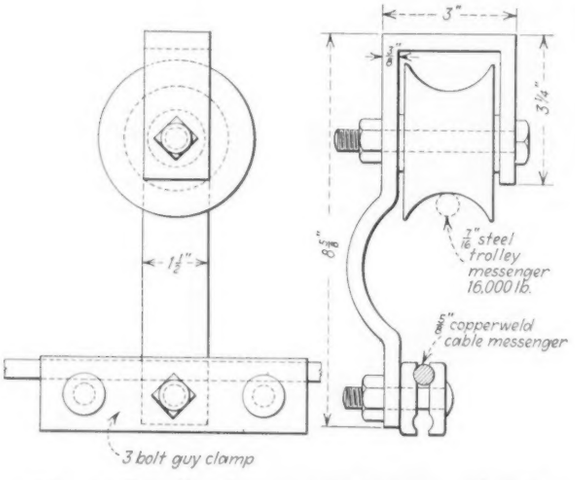


Fig. 2—Details of messenger hanger and pulley

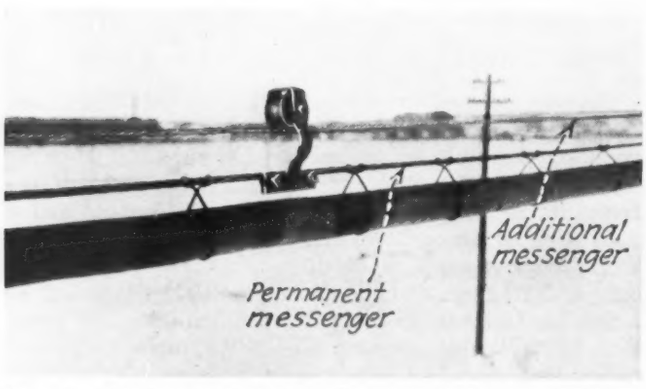


Fig. 3—Close-up of cable suspension ready for trawling

Fig. 1—Additional messenger wire above fixed section of cable, with roller brackets supporting lower messenger and cable

the company that work must be started severe winter weather had set in, making it almost impossible to remove the type H cable without serious damage to it if reeled. Consequently the idea of moving the cable by some other method than through reeling was considered, with the final result that an additional messenger wire was run about 1 ft. above the existing cable for a distance of about 3,000 ft. (Fig. 1). We then employed pulleys with brackets designed as shown in Fig. 2. The brackets were fastened to the original messenger wire by three bolt clamps spaced about 9 ft. apart. The pulleys were then placed on the upper messenger wire. It was found necessary at this point to equalize the tension in both messengers. The next step was to slack off the original messenger from the pole supports, thus allowing the cable to hang free on the newly installed messenger (Fig. 3). This new messenger was sent off from the poles about 6 in. so that no damage would be done to the cable from chafing against the poles during the moving process. The cable was disconnected from the submarine end at the river and opened up in a joint at the end of the 1,500-ft. section.

The necessary snatch blocks and pulling wire were then installed and the operation of moving the cable started. It was really surprising how easily the entire 1,500 ft. of cable, weighing about 22,000 lb., rolled along on the messenger wire to a position under the fixed length of cable. The actual time involved for the movement of the cable was seven hours and the work was

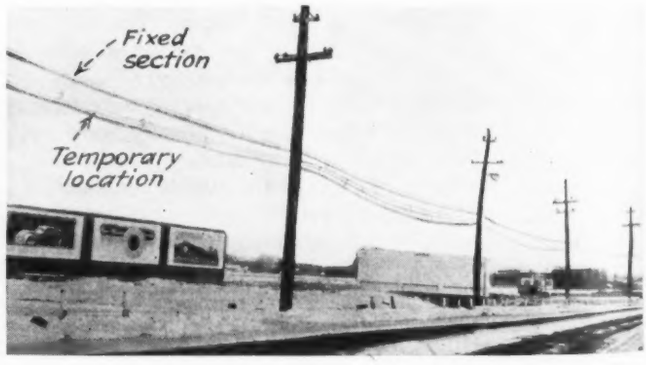
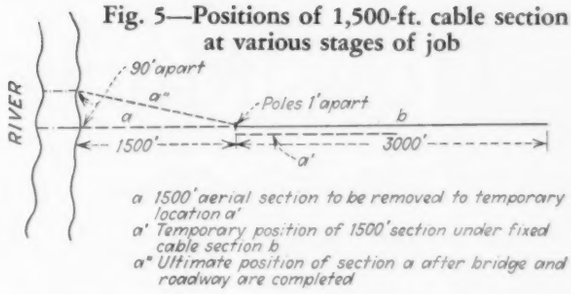


Fig. 4 — Portion of 1,500-ft. cable section temporarily hung below fixed cable section prior to pulling in to final location not visible at left

done by the use of "niggerhead" winches on two line trucks. At no time did the stress applied to the cable exceed the permissible safe limit.

In summing up it should be borne in mind that the method adopted was not on a cost comparison, but rather to avoid mechanical injury to the sheath and also to the paper insulation due to the extreme cold weather. However, actual figures show that the job when completed cost less than would have been the case had we removed the cable and rolled it on reels. The principal savings were brought about by avoiding the necessary labor to place cables on reels and the necessity of rereeling for inspection and repairs, as undoubtedly the sheath would have been damaged by cracks and abrasions from reeling. The ultimate total cost for the job is estimated at $5,800, and while it is not yet complete, as the cable must be pulled from its temporary location under the untouched section to the new pole route, it is felt that a saving of 15 per cent will be effected.

Fig. 5—Positions of 1,500-ft. cable section at various stages of job



The cable is still hanging supported by the bracket and pulleys (Fig. 4), and when the highway and bridge construction has been completed it will be trawled into its new position much as described above.

The operation was rather novel and attracted considerable attention. The final result was perfectly satisfactory as the cable suffered no sharp bends and is ready for reinstallation on very short notice.

Informal opinions on present conditions and problems confronting the industry are helpful. We welcome to this forum the type of discussion presented by Mr. Kelley and hope others will discuss industry questions here in a similar constructive vein.

W. G. Kelley feels that . . .

Plant Design Engineer
Commonwealth Edison Company

Factory-built assemblies offer some disadvantages which manufacturer-user co-operation could minimize

The increasing use of factory-built electrical equipment combining the related parts in a single unit has resulted in many cases in substantial economies. In judging the economies of a factory-built unit combining more than one piece of apparatus versus the same apparatus assembled in the field, the annual charges, including maintenance expenses, must be analyzed and the duration of service outages must be considered. Repairs will usually be more expensive in the case of factory-built units due to the increased cost of handling and assembling larger and more complicated pieces of equipment.

In the case of a factory-built unit the failure of any part of the equipment will usually result in a service outage until replacement can be made. Where, however, separate pieces of apparatus are used it may be possible to restore service quickly after failure of the auxiliary apparatus.

For example, the failure of a tap changer built into a transformer will result in an outage of the transformer; where separate regulating equipment is used in connection with a transformer, service can be restored after failure of the regulating apparatus by its removal and the use of unregulated service. Repairs can then be accomplished more economically, and service restored in a shorter time than would be possible if the entire transformer and regulator as a unit had to be replaced.

Where reserve capacity is provided for a load, as in the case of an alternating-current network installation, the failure of one set of apparatus does not jeopardize the service. The necessary replacement or repairs can also be made without interfering with the service, and the time of equipment outage is not of primary importance. A comparison of the various types of apparatus can be made, under these conditions, without special consideration being given to service outage.

Care should be exercised in trying to combine in a single unit parts having dissimilar functions, as, for example, inclusion in a single case of transformer coils, lightning arresters and cutouts. The function of the transformer is to furnish service, while the function of the arresters and cutouts is to protect the transformer and distribution system under abnormal conditions.

After failure of either the arresters or the cutouts, where separate pieces of apparatus are used, they can quickly be removed and service restored by a lineman in the field. Where they are combined in a single unit the failure of either of the pieces of auxiliary apparatus may involve the transformer and necessitate the replacement of the entire equipment and its return to the shop for repair, resulting in both increased maintenance and duration of service outage.

It therefore appears logical to combine as a unit separate pieces of apparatus having the same function where, due to their application, the failure of any part renders the whole equipment inoperative, but where partial service can be restored with part of the equipment out of service the design should provide for the ready removal of the separate parts of the installation.

More logical application of factory-built units could probably be made if some larger degree of co-ordination could be established between the factory designers and the utility operators, to the end that all of the limitations of installation and operation were thoroughly understood before design work is undertaken.

How Much Reactive Kva.?

A Report on a Study to Determine the Economic Limits and What Corrective Capacity Should Be Provided

By EUSTACE C. SOARES

The R. B. Engineering Corporation, New York, N. Y.

BASIC data for arriving at results to be obtained from power-factor correction comprise, for this study, the record of the power company measuring instruments for a period of one year. Since the utility company's method of measuring power factor is through the measurement of kilovolt-ampere-hours and kilowatt-hours the resulting power factor is an average one. This method of measurement is more or less in common use owing to its simplicity and has the advantage, so far as the energy user is concerned, of requiring less corrective kva. to improve conditions than would be required where maximum demands were used.

The clause in the utility's rate dealing with power factor is quite similar to that found on other properties and is as follows:

> If the power factor as measured is less than 80 per cent, the demand for billing purposes shall be adjusted to 85 per cent; if the power factor as measured is greater than 90 per cent, the demand for billing purposes shall be adjusted to 85 per cent.

Energy consumption data for the year 1933 were made the basis of the calculations because the yearly conditions in the particular plant would vary only slightly. If the condition from year to year should vary more than 10 per cent it would, of course, be better to use average figures covering a period of three years.

When the power rate gives credit for improved power factor it becomes important to determine the most economical power factor at which to operate. This is often a complex problem, because while operation at unity would result in the lowest billing, it is seldom economical to add sufficient corrective capacity to obtain that result. In this article Mr. Soares presents the results of a year's study of a typical case. It offers a simplified basis of calculation that may be generally applied.

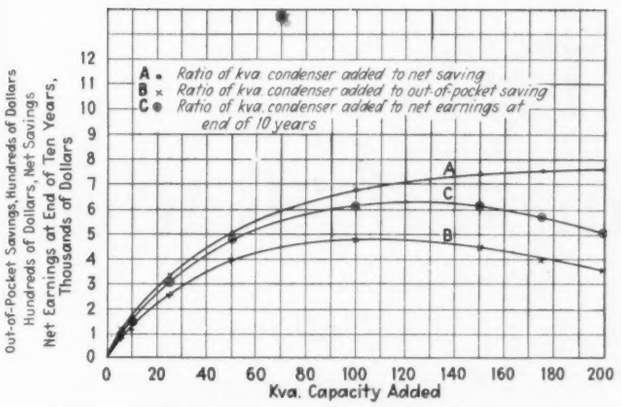
Tabulations were made showing the actual cost of energy on the present power rate with the plant operating as indicated by the metered data. Another tabulation was made showing the minimum possible cost of energy with the plant operating at unity power factor. The difference between these two costs, or $824.97, represents the maximum possible saving if sufficient corrective kva. is added to give unity power factor.

By taking the plant conditions as they were and calculating the effect of adding different condenser capacities, various power costs are obtained that would apply if particular condenser capacities were added. The following condenser capacities were selected: 5, 10, 25, 50, 100, 150, 175 and 200 kva. The power cost was calculated for each of these conditions, thus giving the gross savings per year for each condition. These economies, of course, are savings compared with the actual cost for the year 1933.

While a capacitor is a highly efficient piece of equipment it nevertheless has small operating cost. This cost is tabulated in the summary table and deducted to give the net savings per year for the various condenser capacities. The total investment required for each condenser capacity is then tabluated. This covers labor and material installed under comparatively simple conditions. The true out-of-pocket savings per year are tabulated and the net earnings at the end of 10 years are shown. This is slightly higher than ten times the out-of-pocket savings because it takes into account interest on the money earned as the years proceed. It will be seen that this factor has little bearing on the final results. The out-of-pocket savings are the net savings less the fixed charges comprising interest, taxes and depreciation.

An observation of the out-of-pocket savings discloses that the economic corrective kva. capacity to add is in the neighborhood of 100 kva., representing a total investment of about $1,000. If the results as shown in the summary are plotted in a curve we find that 120 kva. of condenser capacity is more nearly the correct amount to add for the greatest earnings on the investment.

Owing to the fact that the monthly demand and power factor varies somewhat, it will be necessary to have some flexibility in the condenser capacity to prevent operating at too high a leading power factor at times. The simplest flexibility which appears to work out satisfactorily would be to obtain the condenser capacity in two banks —one of 40 kva. and one of 80 kva., thus giving the steps of 40 kva., 80 kva. or 120 kva., as may be desired from month to month. The condenser installation, because of the use of fused disconnects on the capacitor banks, makes it always necessary to shut down the plant by opening the main oil switch before switching out any condenser capacity. If such a procedure is impractical oil switches should of course be provided with each condenser bank. This would add to the investment cost.


A • Ratio of kva. condenser added to net saving
B × Ratio of kva. condenser added to out-of-pocket saving
C ● Ratio of kva. condenser added to net earnings at end of 10 years
Out-of-Pocket Savings, Hundreds of Dollars
Hundreds of Dollars, Net Savings
Net Earnings at End of Ten Years, Thousands of Dollars
Kva. Capacity Added
0 20 40 60 80 100 120 140 160 180 200
0 1 2 3 4 5 6 7 8 9 10 11 12
A
C
B

Curves indicate proper size of capacitor to use

(A) Ratio of kva. condenser added to net savings.
(B) Ratio of kva. condenser added to out-of-pocket savings.
(C) Ratio of kva. condenser added to net earnings at end of ten years.

Table I—Data Obtained from Power Company Measuring Instruments

Month	Actual Kw. Demand	Kw. Hours	Kva. Hours	R.-Kva. Hours	Hours per Month	Actual Average Monthly Power Factor
January.....	124	65,600	74,000	34,500	744	88.65
February....	144	74,800	82,000	33,300	672	91.22
March.....	144	94,400	106,000	48,000	744	89.06
April.....	170	112,000	125,000	52,000	720	89.60
May.....	224	107,600	122,000	57,000	744	88.20
June.....	296	231,600	262,000	123,000	720	88.40
July.....	312	212,000	245,000	122,000	744	86.53
August.....	302	219,600	255,000	147,000	744	86.12
September...	304	178,800	240,000	154,000	720	74.50
October.....	120	78,800	91,500	45,500	744	86.12
November ..	114	36,400	46,000	27,700	720	79.13
December...	36	3,600	4,800	3,120	744	75.00
Total.....	...	1,415,200	1,653,300	847,120	...	.....

Table II—Actual Cost of Power on Present Rate

Billing Demand on Present 1934 Power Rate	Demand Charge	Energy Charge	Combined Demand and Energy Charge	Actual Cost of Power After 5% Discount
124	197	758.80	955.80	908.81
134.2	212.30	834.94	1,047.24	994.88
144	227	988.80	1,215.80	1,155.01
170	266	1,139.00	1,405.00	1,334.75
224	341	1,143.80	1,484.80	1,410.56
296	431	2,138.00	2,569.00	2,440.55
312	451	2.007.00	2,458.00	2,335.10
302	438.50	2,054.00	2,492.50	2,367.88
346.8	494.50	1,792.80	2,287.30	2,172.94
120	191	855.00	1,046.00	993.70
122.5	194.75	518.35	713.10	677.45
40.8	72.20	77.00	149.20	141.74
Total	3,516.25	14,307.49	17,823.74	16,932.57

Table III—Cost of Power if Power Factor Is Raised to Unity

Average Reactive R.-Kva. to Produce Unity Power Factor	Billing Demand	Demand Charge	Energy Charge	Combined Demand and Energy Charge	Actual Cost of Power After 5% Discount
46	105.40	169.10	745.78	914.88	869.14
50	122.40	194.60	826.68	1,021.28	970.22
65	122.40	194.60	962.48	1,157.08	1,099.23
72	144.50	227.75	1,121.15	1,348.90	1,281.46
77	190.40	296.60	1,120.28	1,416.88	1,346.04
171	251.60	375.50	2,093.60	2,469.10	2,345.65
164	265.20	392.50	1,960.20	2,352.70	2,235.07
198	256.70	381.88	2,008.70	2,390.58	2,271.05
214	258.40	384.00	1,704.40	2,088.40	1,983.98
61	102.00	164.00	842.40	1,006.40	956.08
39	96.90	156.35	498.88	655.23	622.47
4	30.60	56.90	77.00	133.90	127.21
Total ...	.....	2,993.78	13,961.55	16,955.33	16,107.60

Table IV—Determination of Power Factor When Various Condenser Capacities Are Added

R.-Kva.-Hrs. with 25 Kva. Condenser	P.F. with 25-Kva. Condenser	R.-Kva. with 50-Kva. Condenser	P.F. with 50-Kva. Condenser	Kva.-Hrs. with 100-Kva. Condenser	P.F. with 100-Kva. Condenser	Kva.-Hrs. with 150-Kva. Condenser	P.F. with 150-Kva. Condenser	Kva.-Hrs. with 175-Kva. Condenser	P.F. with 175-Kva. Condenser
15,900	97.2	.....	100	.....	100	.....	100	.....	100
16,500	97.6	.....	100	.....	100	.....	100	.....	100
29,400	95.5	11,000	99.3	.....	100	.....	100	.....	100
34,000	95.7	16,000	99.0	.....	100	.....	100	.....	100
38,400	94.2	20,000	98.3	.....	100	.....	100	.....	100
105,000	91.1	87,000	93.6	51,000	97.7	15,000	99.8	.....	100
103,400	89.9	85,000	92.8	47,600	97.6	10,400	99.9	.....	100
128,400	86.3	110,000	89.4	72,600	95	35,400	98.7	17,000	99.7
136,000	79.6	118,000	83.5	82,000	90.9	46,000	96.8	28,000	98.7
26,900	94.6	8,300	99.4	.....	100	.....	100	.....	100
9,700	96.6	.....	100	.....	100	.....	100	.....	100
.....	100.0	.....	100	.....	100	.....	100	.....	100

Table V—Summary of Results

Condenser Capacity in Kva.	Gross Savings at Various Condenser Capacities	Less Operating Cost	Net Saving per Year	Total Investment Cost Labor and Material Installed	Total Yearly Interest Earned on Investment in per Cent	Fixed Charges Int., Taxes and Depreciation 20%	Out-of-pocket Savings per Year	Net Earnings at End of Ten Years	Percentage Interest Earned Over Ten Years
5	116.95	1.82	115.13	171	67	34.20	89.93	1,038.95	61
10	167.65	3.64	164.01	245	67	48.90	115.11	1,479.34	60
25	340.49	9.10	331.39	344	96	68.80	262.59	3,133.09	91
50	526.09	18.20	507.89	533	95	106.60	401.29	4,798.49	90
100	714.25	36.40	677.85	1,016	67	203.20	474.65	6,104.08	60
150	794.19	44	750.19	1,503	50	300.60	449.59	6,202.71	41
175	815.99	53	762.99	1,806	42	361.20	401.79	5,709.58	31
200	823.90	62	761.90	2,008	38	401.60	360.30	5,115.22	25

Industrial User's Tests Set New Lamp-Life Ratings

Some Independent Testimony of the Uniformity of American-Made Lamps and Their Performance

By C. C. WILCOX
Superintendent
Power Division,
Studebaker Corporation,
South Bend, Ind.

TO DETERMINE which of two makes of incandescent lamps should be purchased for certain conditions of use in the plant of the Studebaker Corporation at South Bend, Ind., it was decided to make a performance and life test of the two makes. At first glance it would appear wholly unnecessary for any lamp user to make such a test because of the great amount of data readily at hand. Manufacturers have made exhaustive tests to show average life expectancy of their lamps, as well as lumen output, energy consumption, etc. A large number of lamp users had also run tests and some of these were available. It is known also that the well-known commercial testing laboratories have conducted a great many tests and at first it appeared needless to do more than analyze the results of these tests to come to a very definite conclusion as to the best lamp to buy.

One consideration or another, however, eliminated all the test data available, either because it was conducted by an interested party or because it was incomplete for our purpose or gave evidence of inaccuracy. The two makes of lamps selected were believed to be so near alike in characteristics that more than ordinary care seemed necessary to avoid an erroneous conclusion. Other unanswered questions were: "What is the relative effect on performance of variable voltage, and what of vibration?"

There is no lack of data on incandescent lamp behavior, but it is for the most part the expression of controlled tests in the laboratory. Studebaker therefore believed that it could not be taken to represent lamp performance in installed conditions and made its own investigation, to determine which of two makes to buy. These tests demonstrated, not only the uniform standard of American made lamps, but the effect of vibration and voltage regulation on lamp life and the average of actual hours of burning under the abuse of industrial plant service.

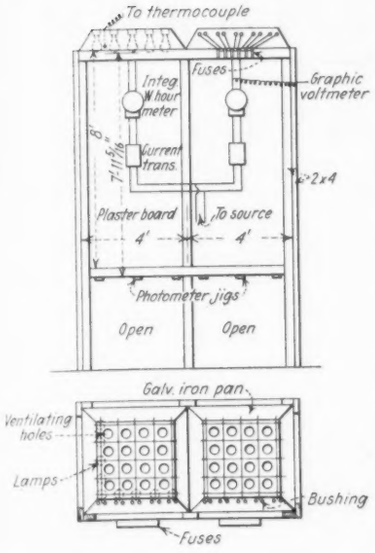
The available tests which seemed to be accurate were all made under conditions of correct and constant voltage and no statement of amount of vibration was included. These considerations which appeared necessary to a complete answer led to the carrying out of the performance test which is here described.

Selection of lamps for test

In the first place the past consumption of lamps in the Studebaker plant was scrutinized to find the size representing the greatest consumption measured in dollar value per year, and this was selected for test. It happened to be a 200-watt clear glass type G lamp known as PS 30, medium base $8\frac{1}{8}$ in. over all, 3,380 rated initial lumens, 1,000 hours rated average life. Twenty-five lamps of each make were taken at random from stock and each one carefully inspected for visible faults, given individual numbers and tested for initial wattage. This was done by a precision wattmeter at exact lamp voltage, and the results are shown in Table I. During this initial test current was placed on the lamp for about ten seconds each. Each lamp was then replaced in the original carton until the test booth instruments were all tested, adjusted and placed in operation, when the lamps were carefully screwed in their respective numbered sockets in the test booth, the construction and arrangement of which are shown in an acompanying illustration.

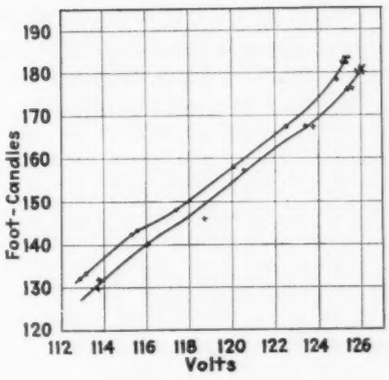
Energy consumption was found by two integrating watt-hour meters, one for each bank of lamps. These meters were compared with a rotating standard before and after the test and found to be within 0.2 per cent correct. They were located as close to the lamps as possible to avoid including unnecessary I^2R loss in leads. A graphic wattmeter was placed in each line to show the exact time of all burnouts, a graphic voltmeter was used to record all variations in voltage and a Weston "Photronic" illuminometer was used for foot-candle readings and exact readings of voltage applied to lamps were

How the lamps were tested



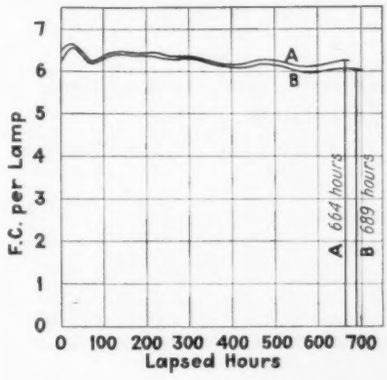
The booth was constructed of standard 4x8-ft. sheet rock plaster board painted dead black inside, making two cells each 4x4x8 ft.; one cell for each make of lamp, but entirely separate as far as light interference between them is concerned. A special fixture was made of galvanized iron supporting 25 sockets in five rows of five each, making five circuits of five lamps each leading from fuse blocks as shown.

The lamps were spaced 8 in. center to center and the outside row was 8 in. from the edge of pan to approximate the setting in an R.L.M. fixture. Ventilation was secured by sixteen 6-in. holes in the galvanized iron fixture located between lamp bases. Previous tests on R.L.M. fixtures fitted with 200-watt lamps showed temperature ranging from 200 to 225 deg. F. at a point ½ in. from the glass surface nearest light center. A thermocouple was therefore similarly placed in each group of lamps to record fixture temperatures and insure carrying on the test under actual operating conditions. The record was made by a two-point Leeds & Northrup temperature recorder.



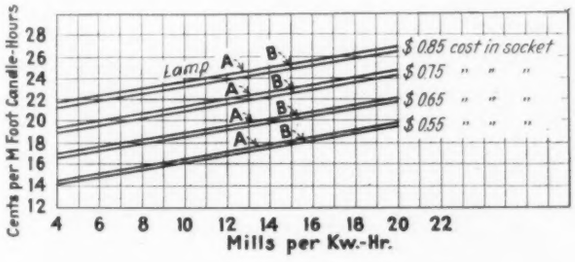
Relation between voltage and light output

Data for this graph were taken with all 25 lamps burning in each group and therefore represent average as well as total performance. The average slope of the curves between 115 and 123 volts is 3.63 F. C. per volt change in the graph. Which is to say that in this eight-volt range a change of 1 per cent in voltage makes nearly a 3 per cent change in illumination.



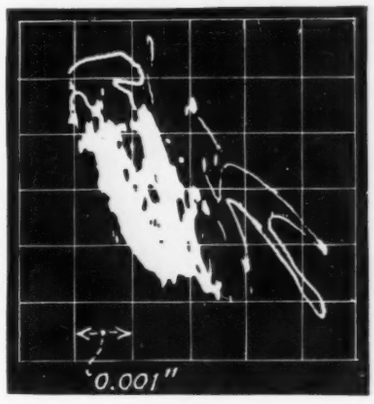
Relation between illumination and lamp life

As would be expected, the lamp of greater light output had the shorter life. The data of this graph are average values of all lamps in the test.



Cost of illumination

This graph is erected on the average lamp data from the test-lamp "B," 14.52 kw.-hr. input and 4,283 F.C.-hours output in 689.1 hours of life, and lamp "A," 14.01 kw.-hr. input and 4,171 F.C.-hours output in 663.91 hours of life. If lamp "B" can be purchased and installed in the socket for 75 cents and electricity cost is 1 cent per kilowatt-hour the cost per 1,000 foot-candles will be 21 cents. To get the same illumination cost on lamp "A" the rate for energy must be 0.87 cent, or the lamp must cost in the socket not more than 73 cents.



Vibration is considerable

Amplitude of continuous vibration is about 0.0025 in., while occasional shocks run to 0.0045.

taken with an indicating voltmeter operated by a double-throw switch from one bank to another. Readings of foot-candles and voltage were taken simultaneously and at times of least voltage variation. Readings were taken daily of all instruments at about the same time. The test was conducted in a room which could be locked up when not in use, and the test booths were connected to one of the factory circuits having normal characteristics as to voltage variation, etc. In this way the lamps were subjected to identical conditions which were typical of normal plant operation.

The burnouts in the order of occurrence are shown in Table I. The average energy consumption per lamp as shown in Table I was found by dividing total kilowatt-hours from the integrating meters by total lamp hours and then multiplying by average life. The light output throughout the life of the average lamp is shown in Table II.

It is well known that vibration shortens the life of a filament lamp and it therefore seemed desirable to subject the lamps under test to such vibration as would be normally experienced in regular use. Accordingly the test booths were located where slight jar due to occasional hand trucking would be received, as well as a more or less continuous vibration from remote factory operations. In order to insure that both sets of lamps received the same degree of vibration a Davy vibrometer was attached successively to each booth and graphs taken of the recorded movement. The accompanying graph shows a typical record of movement in both the horizontal and vertical planes. The axes of the chart are graduated in thousandths of an inch and show the character and extent of movement. This movement was approximately the same for each booth as should be expected, since they were a common structure.

Further to insure as nearly identical conditions as possible, the lamps were very carefully changed from one booth to the other after 512 hours burning so that any

difference in vibration, voltage or photometric conditions which could not otherwise be measured and accounted for would be eliminated. Each make of lamp therefore was not only subjected to conditions as nearly identical as it was possible to secure, but those conditions included such as would be encountered in normal use rather than ideal conditions of the usual laboratory test.

From the tests the following conclusions were readily derived: First, that differences in quality and performance between the two makes are very slight. Second, that lamp "A" gives more illumination than "B." Third, that "B" has longer life than "A." Fourth, that lamp life is much affected by vibration and by voltage fluctuation. Fifth, that the cost of illumination based on equal lamp and energy costs is slightly in favor of lamp "B."

Table I—Record of Lamp Test—The Studebaker Corporation

Lamp Number		Initial Wattage at 115 Volts		Hours of Lamp Life		Total Lamp-Hours to Burnouts	
B	A	B	A	B	A	B	A
8	6	208	205	478.5	506.41	11962.5	12660.25
16	5	207	207	618	511.75	15310.5	12788.41
17	19	208	206	622	553	15402.5	13737.16
19	2	208	208	635.5	579	15699.5	14309.16
1	4	210	212	642.5	591.5	15846.5	14571.66
23	16	208	200	644	596	15876.5	14661.66
4	25	204	208	656	597	16104.5	14680.66
11	22	201	202	658	599.5	16140.5	14725.66
12	12	207	204	658.5	615.5	16149	14997.66
14	13	206	203	659	647.33	16157	15506.94
15	9	208	206	662	655.08	16202	15623.19
6	3	206	209	668	659.16	16286	15680.31
9	1	207	203	683.5	671	16487.5	15834.23
21	18	209	200	683.5	671.91	.....	15845.15
10	8	208	202	711	681	16790	15945.14
20	20	208	204	711	681.25	.....	15947.64
18	17	210	204	715	701.75	16826	16132.14
24	15	206	202	728	707	16930	16174.14
2	24	204	209	741	709.58	17021	16192.2
22	14	208	207	756.5	759.33	17109.5	16463.12
7	23	208	203	763.5	764.25	17137.5	16482.8
5	21	204	209	776	770.5	17175	16501.55
13	7	208	208	792	774.67	17207	16510.89
3	11	208	212	812.5	861.58	17227.5	16597.8
Totals.....				17,227.5	16,597.8		
Kilowatt-hours used in test.....						3,631	3,504
Watt-hours per lamp.....						.....	.....
Hours or watts per lamp.....						210.7	211
Average kilowatt-hours per lamp.....						14.52	14.01
Average hours per lamp.....						689.1	663.91

Table II—Average Foot-Candles per Lamp

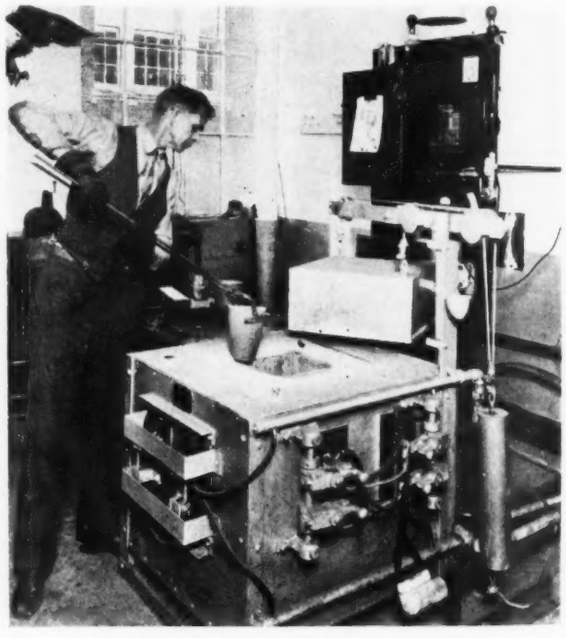
Hours Lapsed	Average Foot-Candles		Average Foot-Candle Hours per Lamp	
	B	A	B	A
0–50	6.51	6.60	343	332.5
50–100	6.16	6.19	308	309.5
100–150	6.40	6.45	320	322.5
150–200	6.36	6.39	318	319.5
200–250	6.36	6.44	318	322
250–300	6.30	6.32	315	316
300–350	6.19	6.23	309.5	311.5
350–400	6.12	6.18	306	309
400–450	6.06	6.12	303	306
450–500	6.18	6.25	309	312.5
500–550	6.02	6.11	301	305.5
550–600	5.94	6.05	297	302.5
600–650	6.04	6.21	302	310.5
650–700	6.00	6.20	234	93.0
700–750	6.00	5.97	...	.....
Totals.....			4,283	4,172

ELECTRICAL

Precious Metals Melted Uniformly the Electric Way

Maintenance of quality production is so vital to the service of dental gold and its alloys that the J. M. Ney Company (established in Hartford, Conn., in 1812) adopted electric melting after considerable experience with gas. This manufacturer of gold alloys, gold leaf and other precious metal products uses a 24-kw. Hayes electric furnace with Globar heating elements to obtain the necessary temperatures in the 2,400 to 2,700-deg. F. range. Automatic control of predetermined temperatures is obtained by a Leeds & Northrup control outfit and a Sundh switching cabinet mounted on the wall at the rear. The furnace now has six heating elements connected in parallel and mounted inside the heating chamber in two vertical rows of three each, although at the time the photograph was taken eight units were in use. Water-cooled terminals are required as shown, and energy is supplied at 110 volts, single phase.

When the elements are new only 75 to 80 volts is required to energize them to the necessary heating level. A booster transformer is provided at the rear of the furnace with four voltage steps by which the increasing resistance of the units can be overcome as they age in service. Pilot lights at the right and left of the control panel indicate when the furnace interior has reached 2,400 deg. and when current is on the elements, respectively. A normal charge in a sand crucible weighs from 700 to 1,000 pennyweights Troy, and melts usually run from 50 to 80 per cent gold by weight and from 3 to 30



Gold melting furnace avoids remelting precious metal charges

per cent platinum. The maximum temperature, about 2,700 deg. F., is required in melting certain platinum-palladium alloys. The Globar element life averages about 500 hours.

In operating it is customary to bring the temperature of the filled crucible slowly up to a red heat to avoid cracking, this heating being done in another adjacent furnace. When the crucible is introduced into the electric furnace, this having been brought up to about 2,400 deg. for a gold melt, the temperature drops about 25 deg. on opening it to receive the charge. About twenty minutes is required to restore the lost temperature. The melting temperature is then maintained for from 15 to 25 minutes, as required. In a test in which fifteen small-wire (gold-platinum alloy for dental use) melts were run off in seven hours' work the furnace consumed 130 kw.-hr., a separate watt-hour meter being permanently installed for this apparatus. The improvement of atmospheric conditions has been advantageous compared with gas operation, but the main benefit of the electric furnace has been control of quality production and assured repetition of performance with charges often worth $1,000 each.

1,200-Kva. Condenser Quickly Saves Own Cost

By M. A. DE LEW
Electrical Engineer Associated Oil Company, San Francisco

Following the trend of manufacturing companies to lower production costs by the introduction of more economical methods and efficient apparatus, the Associated Oil Company of California, after careful consideration, purchased and installed a static condenser to improve the power factor at its Avon refinery. Energy for operations is purchased from the Pacific Gas & Electric Company under a schedule which provides for a credit allowance of 5 per cent on the monthly bill in the event that the power factor is "unity." A deduction of two-tenths of 1 per cent of the above amount is taken for each point under unity.

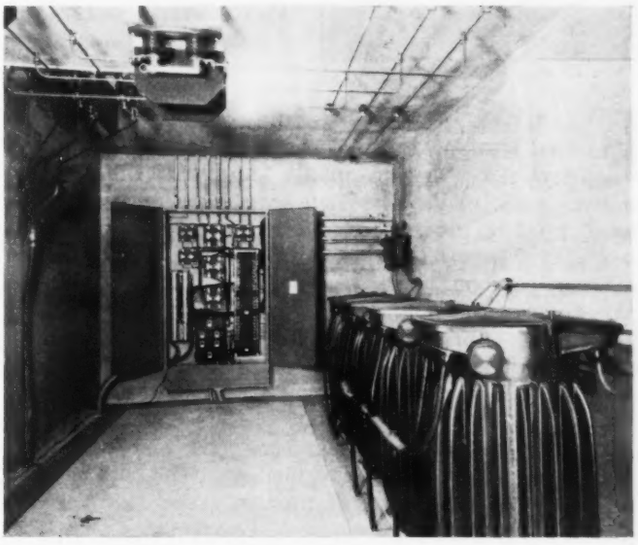
To effect a saving of approximately 5 per cent a 1,200-kva. condenser, together with protective panel and control apparatus, was installed. With this equipment the average monthly power factor, for the past nine months, was raised from 0.84 to 0.98, returning to the Associated Oil Company a discount of 4.6 per cent. Assuming the next nine months will show equal results, the bonus received will return the investment plus fixed charges within the period.

The installation consists of 108 cells set in three single rows on a substantial steel rack, well braced and covered with a steel net. Each cell has a capacity of 10 kva. at 2,200 volts. The operating voltage being 2,350 volts, the rating is therefore above the nominal.

Control is lodged on a special panel of the main switchboard in the substation, in which the condenser is located. This panel consists of a 650-amp., 2,500-volt, three-pole, oil circuit breaker of the instantaneous opening type. The opening of circuit, including relay time, is 3½ cycles. The interrupting capacity of switch is 15,000 amp. Included with the above is a polyphase watt-hour meter, instrument coils and test block.

When properly installed in a suitable location the useful life of the condenser should exceed an industrial generation. A considerable load was added at the same time the condenser installation was made. The corrective effects of the condensers were quite sufficient to offset any additional kva. load, thereby saving a new primary installation by the power company.

Semi-Permanent Design Insures Vault Flexibility



Accessibility and economy gained by using exposed runs

Illustrative of advanced design in industrial transformer vaults is that shown for a Pacific Coast installation. Features include the use of a specially shaped pothead suitable for mounting against the wall for bringing in the high-voltage leads on underground systems. The exposed bus, mounted on the ceiling, is accessible without being hazardous and feeds a bank of four transformers through conventional disconnects. Three of the transformers are used for power and a fourth for the lighting service. Control and lighting services pass through the inclosed cabinet at the end of the vault. This cabinet is of interest because of its complete accessibility, the use of two terminal strips for identifying circuits and because of the bank of snap switches controlling the lighting circuits in the building through magnetic switches shown above and to the left of the panel.

The concrete channels shown in the floor provide an economical and accessible means of carrying the secondary circuits from the transformers. These channels also provide a means of handling other circuits and permit the use of lead-covered cable rather than the conventional conduit service.

What Should Be the Cost of City-Wiring Inspection?

Milwaukee Figures Its Unit Costs, Checks the Staff on Performance and Works Out a Fee System

By
WILLIAM A. HAIG
Chief Electric Inspector, Milwaukee

The value of municipal electrical inspection is universally recognized, but little is ever said about its cost. How long should it require for an inspector to make an average inspection? What is an adequate inspection staff? Now come these figures from Milwaukee giving an opportunity for other cities to compare their inspection expense on a unit basis, with a yardstick to measure efficiency. Better cost control is needed to speed the coming of systematic reinspection. This may help.

EXPERIENCE in Milwaukee shows that twelve men working seven hours a day for 265 working days per year will, in the 111,300 working hours in five years, make 205,342 inspections. Actually, the number made ranged from 27,455 in 1932 to 48,961 in 1929. There have thus been 1.85 inspections made per man per hour. For simplicity in estimating and to take cognizance of the recent abnormality in departmental load it may safely be assumed that there can be two inspections per hour per man, or fourteen per man per seven-hour day in the field, or 364 per 26-day month.

If an inspector greatly exceeds 364 inspections or its equivalent per month the quality of his inspections is suffering through lack of time to make a proper inspection. If, on the other hand, he regularly falls far below this figure it is plain that he should be assigned additional duties. In other words, with this information it is simple to distribute work equally among the men and serves as an aid in comparing the efficiency of one inspector with another.

Where an inspector is performing special work differing in character from the general routine his time can be converted to an "inspection base" by multiplying his time by two (the number of average inspections per hour). Thus, if a man makes two regular inspections and then spends six hours on "specials," those specials will be rated as equivalent to twelve regular inspections. This facilitates the use of the accompanying chart for quick calculations.

Trailing largely superseded

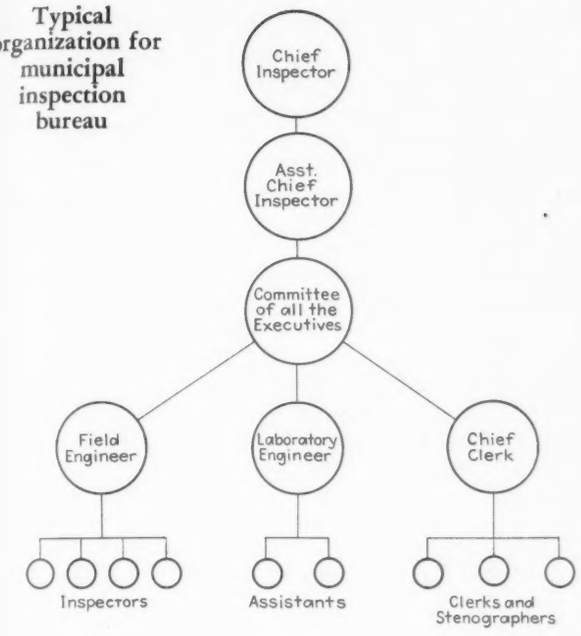
The use of this chart practically eliminates the necessity of "trailing" inspectors in the field to make sure that they are performing a full day's work. Unexpected examinations of the "job sheets" concerning the genuineness and need for the inspections is all that is necessary. If an inspector's job sheets show that inspections were needed and his total inspections are fairly close to the chart figures, the chances are greatly against his having wasted any time. In any event, this method of checking inspectors has much merit to recommend it, because it makes possible the frequent checking of a large group of inspectors and can be used in conjunction with the "trailing" method to provide a highly efficient class of supervision.

One inspector making fourteen inspections per day would make 3,710 inspections in a 265-day year. On this basis the normal capacity of a twelve-man department should be 44,520 inspections per year. Under these conditions the number of inspectors needed can be estimated by dividing the anticipated annual number of inspections by the annual capacity of one inspector. In this case 44,520 ÷ 3,710 equals twelve inspectors needed.

However, since the importance of reinspecting electrical work has been established and since much new electrical work is installed in old buildings, it is plain that the number of inspections of a municipal electrical inspection department does not vary exactly with the volume of building construction. Therefore, because of this fact there is a tendency to "man" electrical inspection departments on the basis of population rather than "building figures." "A man and a car for every 50,000 people" seems to be the minimum average practice.

What it costs a city to make an average inspection can be found, of course, by dividing the total expense of the department by the number of inspections. The 205,342 inspections made in Milwaukee in 1928-1932 cost $271,087 or $1.32 per inspection. With a more balanced load and staffing it is reasonable to assume that this cost (on

Typical organization for municipal inspection bureau



a two-inspection-per-hour basis) would have been $1.21. This has its bearing on the fixing of permit fees for revenue purposes.

The total receipts from 48,795 permits over a five-year period amounted to $139,000, or an average of $2.85 per inspection. The year 1929 had 13,676 with a revenue of $41,000 and 1932 had 5,426 with $10,000 gross receipts.

Inspectors paid same as contractor's superintendent

Inspectors' salaries should never be based on "what other cities are paying." Such a base is unscientific because "other cities" without question have been guided by what still other cities were paying, and so on indefinitely, with no assurance that the original or base city used any fair or intelligent means in arriving at its schedule.

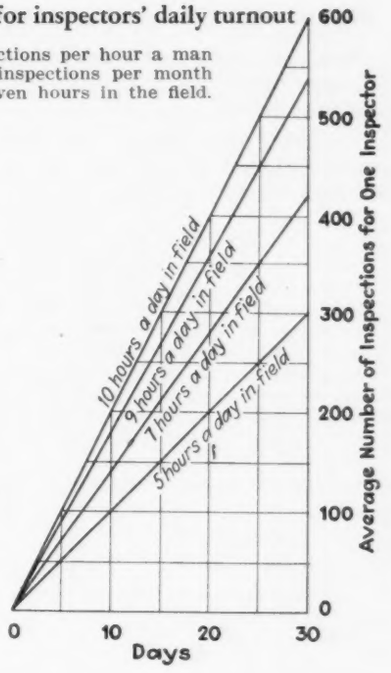
The results of a careful analysis of this question show that an inspector should receive a salary equal to that paid a contractor's superintendent in the locality in question.

In speaking of the department as a whole, it is sometimes necessary to state the average salary. The weighted average formula is the one used for this purpose. On a weighted basis the average salary shown in Table III is $2,968.75.

Electrical inspection costs about 2 per cent of the electrical installation cost and this has been running about 2 per cent of the cost of a building, according to the U. S. Department of Labor (see Table IV). A $10,000 house would, according to this low estimate, represent $200 in wiring and entail an inspection of $4. This $4 inspection fee is probably truly representative of the actual worth of inspection when you consider that at least three inspections are necessary in a building of this class and average inspection cost amounts to $1.32 each.

Quick check afforded for inspectors' daily turnout

On the basis of two inspections per hour a man should make nearly 300 inspections per month in 21 working days of seven hours in the field.



Where an inspector is concerned with condemning an old installation, it is convenient to have some information dealing with the depreciation rate of electrical equipment. Depreciation is a decline in value of property as a result of wear and tear and gradual obsolescence. For many years it has been the "unofficial opinion" that when an installation has deteriorated 50 per cent from its original state it should be replaced rather than repaired. However, the difficulty in the case of municipal inspectors has been in arriving at a conclusion as to when an installation has reached any given percentage of deterioration. It is sometimes useful to know that for valuation accounting purposes electrical equipment taken as a whole will depreciate on an average of about 5 per cent a year. Sometimes the "after charges" of fire insurance rating bureaus serve to indicate the condition of the installation. Under the various methods of fire insurance rating (analytic system, universal schedule, etc.) defective or non-standard electrical equipment is penalized from 3 to 25 cents per hundred dollars coverage, depending upon the extent of the hazard as well as the class of building involved.

Table IV—United States Department of Labor Divides "Building Dollar"

(Figures include labor and material.)

	Per Cent of Cost		Per Cent of Cost
Foundations and masonry	36.1	Hardward, metals	7.6
Carpentry	29.1	Paint	6.5
Plumbing	10.0	Electric wiring and fixtures	2.0
Heating	8.7		
		Total, per cent	100

Table I—Average Inspections Cost $1.32 Each

Year	Expenses	Inspections
1932	$49,444	27,455
1931	59,770	42,932
1930	59,596	46,378
1929	55,329	48,961
1928	46,948	39,616
Total	$271,087	205,342

Table II—Average Permit Fee Is $2.85

Year	Permits	Fees
1932	5,426	$10,000
1931	7,451	18,000
1930	9,949	28,000
1929	13,676	41,000
1928	12,283	42,000
Total	48,795	$139,000

Table III—Typical Salary Schedule for Inspection Bureau

No. of Individuals	Year's Salary	Total
1 Chief inspector	$5,500.00	$5,500.00
1 Asst. chief inspector	4,500.00	4,500.00
10 Inspectors	3,000.00	30,000.00
1 Chief clerk	2,500.00	2,500.00
1 Clerk	1,500.00	1,500.00
2 Stenographers	1,750.00	3,500.00
16 People	$18,750.00	$47,500.00

Probably the best method for an inspector is to make a visual examination of the installation for broken and defective parts and follow up with an insulation resistance test in accordance with the table which follows. A completed installation shall have a resistance between conductors, and between all conductors and ground, not less than the following:

Up to	Ohms	Up to	Ohms
5 amp.	4,000,000	200 amp.	100,000
10 amp.	2,000,000	400 amp.	50,000
25 amp.	800,000	800 amp.	25,000
50 amp.	400,000	1,600 amp.	12,000
100 amp.	200,000		

The above values shall be determined with all cutouts and safety devices in place. If lamp sockets, receptacles, fixtures and other appliances are also connected, the minimum resistance required shall be one-half that specified in the table.

A department without statistics never knows in which direction it is going. It lacks material and facts on which "to present its case" in the matter of salary schedules, permit fees, etc. The amount and importance of the "department's activities" is discernible only through statistics. The increase or decrease of electrical fires and accidents can be set down in actual figures if the proper statistics are available. Statistics properly used is an easy way in bringing to public attention the true complexion of a municipal department, therefore statistics as follows should always be part of a department's records:

Department roster. Organization chart. Salary schedule.
Average salary. Time records. Receipts and expenditures.
Permits issued. Fees collected. Average permit fee.
Inspections made. Time devoted to special work.
Average time per inspection. Average cost per inspection.
Inspection capacity of the department.
Inspection capacity of one inspector.
Notices sent for correction of work. Court actions.
Electrical accidents. Electrical fires. Yearly financial balances.

Water Heater Customers Earn 45% Household Rate Cut

A reduction of 45 per cent in the average price paid for electricity has been effected by the use of water heating service by 100 residential customers of the Edison Electric Illuminating Company of Boston over a period of one year. An analysis of the energy consumption and bills of these customers has recently been completed by the company with the object of showing how even a promotional rate designed for general home use may be automatically lowered in terms of over-all price per kilowatt-hour when electric water heating is combined with all other service. All of the bills analyzed applied to installations where water heating on the company's off-peak storage service rate had been in operation for at least a year, and in the majority of cases the customers were also users of electric ranges.

The customers were located in about 24 cities and towns of the company's territory, and in the year's service their over-all average rate paid for service was 2.28 cents per kilowatt-hour. The average paid on the residential rate by these customers, excluding water heating, was 4.15 cents and the average rate paid for water heating itself was 1.13 cents per kilowatt-hour.

The regular residential rate applying to these customers is the company's so-called "B" rate, in which the prices are 7.5 cents per kilowatt-hour for the first 2 kw.-hr. per 100 sq.ft. of floor area; 5 cents per kilowatt-hour for the next 70 and 3 cents per kilowatt-hour for the excess. The minimum area is 1,000 sq.ft. The water heating tariff, or so-called "L" rate, is 3 cents per kilowatt-hour for the first 25 kw.-hr. consumed per month and 1 cent per kilowatt-hour for the excess. This rate is restricted to off-peak use of energy, off-peak hours being defined as hours other than from 3 p.m. to 10 p.m. from October to April inclusive, the company having the right to establish other peak periods if it desires.

The total area of the installations as billed was 160,000 sq.ft., or an average of 1,600 sq.ft. per installation. The amount of energy consumed under each rate, of course separately metered; the total bill under each rate and the average price of electricity as it worked out under each rate, as well as the energy consumption, billing total and unit price under the combined results of the two schedules are given in the table.

Besides the summary (lines 1 and 2) the table includes the year's billings and rates per kilowatt-hour applying to the customer in the group having the maximum residential area (4,200 sq.ft.), maximum use of energy on the "B" rate (7,864 kw.-hr.), maximum use of energy on the "L" rate in water heating (14,638 kw.-hr.), minimum use on the "B" rate (292 kw.-hr.) and minimum use of water heating on the "L" rate (1,262 kw.-hr.).

It is noteworthy that the customer using the largest amount of energy for water heating obtained that service for 1.03 cents per kilowatt-hour, while the one using the least paid an average of 1.48 cents. Note in examining the "B" rate results that lamp renewal service is included in this tariff and averages about 2.7 mills per kilowatt-hour based on 1932 figures of the company. Sixty-nine of the 100 customers earned a rate under 2.5 cents per kilowatt-hour for their total residential service and 93 customers paid under 3 cents. The conclusion seems inescapable that if electric water heating becomes generally used in the home residence rates will drop to average figures of such low level that they will largely lose their political interest when compared with present tariffs maintained by political units for household service.

Energy Use and Billings for General Residential Service Rate "B" and Off-Peak Water Heating Rate "L"
Boston Edison Company—100 Customers and 12 Months' Service

		Rate "B"			Rate "L"			Combined Services		
	Sq.Ft. Area	Kw.-Hr.	Amt. Billed	Cents per Kw.-Hr.	Kw.-Hr.	Amt. Billed	Cents per Kw.-Hr.	Kw.-Hr.	Total Bills	Cents per Kw.-Hr.
1 Total	160,000	281,149	$11,676.04	4.15	458,338	$5,171.21	1.13	739,477	$16,847	2.28
2 Average	1,600	2,811	116.76	4.15	4,583	51.71	1.13	7,394	168.47	2.28
3 Maximum area	4,200	2,582	127.21	4.93	5,560	61.60	1.11	8,142	188.81	2.32
4 Maximum kw.-hr. "B" Rate	1,500	7,834	268.02	3.42	6,948	75.48	1.09	14,782	343.50	2.32
5 Maximum kw.-hr. "L" Rate	4,200	2,100	109.62	5.22	14,638	150.88	1.03	16,738	260.50	1.56
6 Minimum kw.-hr. "B" Rate	2,100	292	21.90	7.50	2,382	29.82	1.25	2,674	51.72	1.93
7 Minimum kw.-hr. "L" Rate	1,000	1,246	64.82	5.20	1,262	18.62	1.48	2,508	83.44	3.33

LETTERS TO THE EDITOR

Massachusetts Takes a Stand

To the Editor of the ELECTRICAL WORLD:

I wish to thank you for the editorial "Massachusetts Takes a Stand for Justice and Good Service," published on page 570 in your April 21 issue. I have received favorable comments on this from a number of friends in the power industry and think the ELECTRICAL WORLD has hit the nail on the head in its interpretation of this decision.

We find ourselves in troublesome times, with some utility companies suffering in reputation after the previous years of so-called "depression-proof" industry service to the public. However, if further inflation is not too drastic, if taxation does not proceed too far and if we can develop the necessary volume of kilowatt-hour sales at reasonable rates, then the situation may well find the utility companies recovering as rapidly as other lines of industry.

J. A. COOK,
General Superintendent.
Electric Department,
Lynn (Mass.) Gas & Electric Company.

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The Barrier Raised

To the Editor of the ELECTRICAL WORLD:

In a brief article on page 474 of the March 31 issue of the ELECTRICAL WORLD W. G. Kelley mentions the rule prohibiting the interconnection between the transformer secondary neutral and the lightning arrester ground protecting the transformer as one of a number of restrictions existing that are retarding the advance of the electrical industry.

In the National Electrical Code this interconnection is recognized in paragraph k, Section 909, of the 1933 edition. This recognition in the National Electrical Code was accomplished within approximately one year from the time when the practice was first advocated and at the first opportunity provided for consideration of the matter by the electrical committee.

A. R. SMALL,
Chairman.
Electrical Committee,
National Fire Protection Association.

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Range Wiring Costs Again

To the Editor of the ELECTRICAL WORLD:

I note V. C. Moulton's letter on page 629 of the April 28 issue, giving criticism of an article on page 518 of the ELECTRICAL WORLD of April 7, "Range Wiring Costs Cut to $17." Mr. Moulton undoubtedly properly and correctly interprets the National Electrical Code as applying to the text and illustrations of that article. However, there is an item of customer's protection with which the authors, and ourselves, are not at all satisfied, as covered by the requirements and limitations circumscribed by the National Electrical Code as it now stands. The code does not require the grounding of such devices as the frame of the electric range, but it does preclude the grounding of same through the grounded neutral conductor; to all practical purposes, this forestalls the grounding of the frame of such appliances. The user of the appliance is thus denied the protection which could be had so simply and so safely.

It is our thought that identified wiring and thorough grounding of the neutral of such wiring is so well recognized a practice that some of the ultra-conservatism which has limited the application of good engineering should be withdrawn from the text of the code and the user of such equipment permitted the protection that may be obtained through practicable grounding methods.

D. D. CLARKE,
Electrical Engineer.
Kansas City Power & Light Company.

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Motors for Air Conditioning

To the Editor of the ELECTRICAL WORLD:

I have noted in the April 28 issue of the ELECTRICAL WORLD E. H. Cheney's letter on my article, "Plan Now for Desirable Air-Conditioning Load," which appeared in your March 17 issue.

With reference to the first quotation from my article given by Mr. Cheney in his letter, I can only say for the benefit of those to whom it has not been evident from the context that my remarks related to the single-speed, squirrel-cage motor. Since the intent of my article as a whole was a plea for maximum simplicity in equipment, I did not discuss the use of the well-known multi-speed squirrel-cage motor because of the complication it entails in wiring, switching and automatic control.

Concerning the second quotation given by Mr. Cheney, I can only say that it is merely a correct statement of facts. I did not intend it as—nor do I find it to be—a broad condemnation of all repulsion-start, induction-run motors. Even with the "brush-lifting" type of motor there may be radio interference during the frequent starting periods, and, as I stated, "special filtering equipment for eliminating radio interference may be necessary in many places." Such a fact in itself does not constitute a broad condemnation of a certain type of motor, and it may be of interest to Mr. Cheney that the Westinghouse Electric & Manufacturing Company is supplying propulsion-start, induction-run motors on certain commercial refrigeration equipment which is very closely related to air-conditioning equipment.

Even in the case of air-conditioning equipment, where a particularly low starting current is required on account of voltage regulating conditions, or where the compressor design imposes exceptionally severe starting torque requirements, the choice of a repulsion-start, induction-run motor may be well justified. On the other hand, although I did not so state in my article, I personally prefer the capacitor motor. Again, my statements regarding this can hardly be construed as a broad condemnation of the repulsion-start, induction-run motor. In commercial refrigeration equipments, which are installed in commercial establishments and therefore usually in more accessible places and not in very close proximity to radio receiving apparatus, the repulsion-start, induction-run motor might be given preference over the capacitor motor.

R. E. HELLMUND,
Chief Engineer.
Westinghouse Electric & Manufacturing Co.
East Pittsburgh, Pa.

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Fuse-Breaker Status

To the Editor of the ELECTRICAL WORLD:

Your editorial on fuses in the April 7 issue of ELECTRICAL WORLD is, we believe, somewhat ill-advised. While there are instances where fuses will answer the purpose, there is no substitute for an oil circuit breaker for distribution purposes. If there is any drift back to fuses, it is a temporary one caused by the present financial situation, and not, we believe, a permanent tendency.

A fuse has always been a more or less makeshift proposition. It is affected by climatic and operating conditions to a point where its operating characteristics are by no means capable of close calculation. This probably explains why the fuse manufacturers have been reticent to furnish engineering data. They realize that it is of little value. Again, it is often necessary to interrupt the circuit for other reasons than overload, and a fuse is not well adapted for this purpose. A fuse, moreover, may interrupt only one phase of a circuit on overload, whereas the opening of a circuit breaker completely kills the circuit. Finally, restoration of service, even with so-called repeater fuses, does not give the same results obtainable by an automatic reclosing circuit breaker installation.

The primary consideration in the selection of an overload device is therefore limited to the initial cost. This company started in business ten years ago to produce automatic reclosing circuit breakers at a price that would justify their use, even on feeders serving areas of low revenue. It has succeeded in bringing down the price level of this class of equipment to the point where scarcely any saving can be made by employing fuses. Your editorial mentions a $500 fuse installation in place of a $4,000 or $5,000 breaker on 11,000-volt rural service, but I can assure you that first-class equipment can be obtained for a great deal less than $4,000. For example, this company manufactures a 50,000-kva. automatic reclosing circuit breaker that sells for slightly more than $750. I do not think the operating companies would spend much time arguing about the difference between a $750 breaker and a $500 fuse installation.

I believe that while your editorial is undoubtedly based on the statements made by Mr. Pearson, it will create a wrong impression in the mind of the engineer who has not gone into the matter of fuse vs. breaker thoroughly. Of course you are at perfect liberty to retaliate by saying that if we had done a first-class advertising job all the engineers would know that we could furnish circuit breaker equipment at very little more than the cost of a fuse.

R. S. SEESE.
Automatic Switch Company, Detroit, Mich.

NEWS OF THE WEEK

Lacking Large Bail, Insull Is Jailed

Returned to United States after two-year exile, Insull is sped to Chicago, held for lack of $200,000 bail. Issues statement written by son. Calls mistakes "honest."

Samuel Insull returned to American soil this week after an absence of two years. Within 30 hours he was lodged in Cook County jail, a federal prisoner, for lack of $200,0000 bail, the highest in the history of the Chicago federal courts.

Mr. Insull was taken from the *Exilona* at Ambrose Lightship, as his ship neared

Wide World

Back—Samuel Insull and U. S. Istanbul Legation Secretary Berry, who saw him home

New York, placed aboard a Coast Guard cutter and, together with his escort, Burton Y. Berry, secretary of the United States Legation at Istanbul, was rushed to Princeton Junction to board a Chicago-bound express. Arriving in Chicago he was turned over to Federal Marshal H. C. W. Laubenheimer, who took him before Federal Judge John P. Barnes. Despite the pleas of his attorney, Judge Barnes set bail at $200,000.

A prepared statement was issued by Mr. Insull while aboard the Coast Guard cutter. Although the statement was written before his arrival by his son, Samuel Insull, Jr., the father released it as an accurate expression of his sentiments. The collapse of his companies was laid to honest errors of judgment, and his European exile was explained as the result of a desire to give the new management of his former companies a free hand in reorganization of the properties. No date has been set as yet for the trial. The first charges that must be faced are federal actions involving use of the mails to defraud.

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Georgia Appliance Dealers Seek to Enjoin T.V.A.

Ten Georgia refrigerator dealers this week obtained a temporary injunction preventing the Georgia Power Company from participating in the Electric Home and Farm Authority's sale of low-priced appliances. The dealers charged that the Tennessee Valley Authority has coerced electric appliance manufacturers and power companies into a plan which would create a monopoly in the sale of appliances and destroy their business. A hearing on the temporary order will be held today in Superior Court. More than $400,000 is invested in their businesses, the dealers argued. This investment would be destroyed if the T.V.A. project is completed, they asserted.

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New York City May Tax Electrical Merchants

Licensing of all New York City stores selling electrical merchandise is forecast in an ordinance drafted by Maurice P. Davidson, Commissioner of Water Supply, Gas and Electricity. The sale of such appliances and merchandise would be subject to city approval. Electric light bulbs would be exempted from the licensing provision.

Under the terms of the proposed ordinance every store in the city that sells electrical equipment would have to pay $15 for the first year and $10 for annual license renewals. The ordinance provides that all new types of electrical appliances must be first inspected by his inspectors, Mr. Davidson said.

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Federal Power Commission Studies California Project

A careful study is being made by the Federal Power Commission of the Central Valley project of the state of California. An application for license under the water-power act has been filed. The project provides for the ultimate expenditure of $170,000,000. It involves irrigation and flood control as well as power development. Two hydro plants will be built at dams to be erected in the Sacramento River headwaters. At Kenneth Dam equipment capable of developing 295,000 hp. and at Keswick Afterboy Dam 55,000 hp. would be installed. Friant Dam, on the San Joaquin River, would have an installation of 35,000 hp.

Stimulus to Industry Seen in Housing Plan

President expected to submit $1,500,000,000 program to Congress. House repair, improvement and construction to receive government aid.

A $1,500,000,000 housing plan, offering real opportunities to the electrical industry, will be the next step in the New Deal recovery program. President Roosevelt is expected to submit the plan, evolved by the National Emergency Council, within the next few days to Congress for permissive legislation. As presently conceived the program proposes:

Modernization of existing houses that are worth the cost.

Stimulation of new home construction that can be justified.

Demolition of obsolete construction by discouraging repair of such structures.

Repair and replacement of industrial structures.

While the program calls for expenditures of $1,500,000,000, the government will incur liability of only $200,000,000, which probably will not require additional Congressional appropriations.

Operations to be decentralized

Under the present reconditioning plan the Home Owners Loan Corporation will distribute the $200,000,000 fund to any home owner in distress, whether or not he has received previous aid from the corporation. A decentralization of operations is a fundamental part of the plan, the policy being to encourage as far as possible the use of local facilities, including labor, purchase of materials, etc.

Officials have set up three types of work under the general heading of reconditioning. These include repairing, which means putting a house in livable condition; remodeling, which requires a basic structural change, and modernizing, which bases the standard of the home above its original intent.

In seeking a loan the home owner will go to the office of the corporation nearest to him. If the office finds he is entitled to aid he will be given a list of contractors, and from it will choose three. These may then bid for the job, the lowest bidder getting it.

Home reconditioning, other than of distressed homes, would be undertaken with a new type of consumer credit instrument. Banks, finance companies, insurance companies and building and loan associations would be induced to make loans of $200 to $2,000 at 5 per cent interest through insurance by a government agency of the credit risk to an extent making it reasonably certain they would incur no loss.

New home construction, the major goal of the program, contemplates the

offering of a partial government guarantee on mortgages issued against such construction, combined with comparatively small expenditures of Public Works funds. It is believed that the Treasury will guarantee 80 per cent of the face value of this paper and that it will carry 5 per cent interest.

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Blast Destroys Towers of Appalachian Lines

Watchmen are patrolling the high-tension lines of Appalachian Electric Power Company after the third blast within a month destroyed two steel towers in Russell County, Virginia., on May 6. An unexploded charge, evidently designed to destroy service over an alternative line, was discovered, company officials revealed. The first two explosions, which occurred on April 22, forced a complete shutdown of the Clinchfield Coal Corporation's mines.

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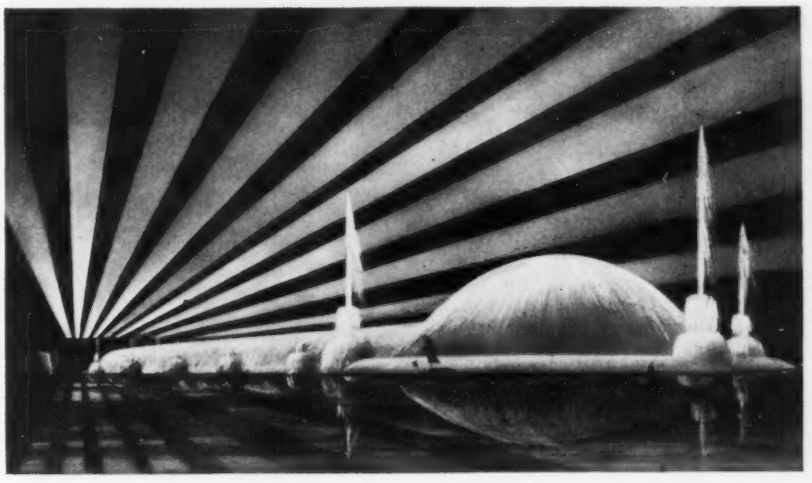
Appliance Control Denied by Wisconsin Commission

The legal department of the Wisconsin Public Service Commission has ruled that the commission has no jurisdiction over unfair competition in merchandising gas and electrical appliances. The ruling was made following complaint to the commission by a Kenosha appliance dealer. He had been refused membership in a local bureau of appliance dealers whose refrigerator sales were financed by the Wisconsin Gas & Electric Company. As a result his financing costs were higher than those of other dealers, complainant asserted.

The commission's legal department stated that if the merchandising of appliances was related to rates and service the commission might have jurisdiction. Otherwise it was not considered a utility business.

LARGEST OF FOUNTAINS TO DOMINATE WORLD'S FAIR



As the ferris wheel featured the 1893 World's Fair and the Sky Ride dominated the scene at the 1933 Century of Progress Exposition, this year's spectacular element at Chicago will center on the largest and most brilliantly illuminated fountain in the world. This fountain, 670 ft. in length, will require a flow of 68,000 gal. of water a minute. Lighting effects in five colors, diffused by "Thyraton" tube control, will be obtained from floodlights imbedded under the dome and along the entire length of the fountain. This will permit an infinite gradation and change of color. Back of the fountain a bank of 40 searchlights will create a giant "aurora borealis" in shifting hue.

Small Manufacturers Recovering

N.E.M.A. survey shows entire electrical industry employment totals up. All but largest plants show sales improvement. Small manufacturers only group to make profit in 1933. Indicates NRA operation beneficial.

All classes of manufacturers in the electrical manufacturing industry show decided improvement with respect to the number of employees now actively engaged in production as compared to February a year ago, the National Electrical Manufacturers Association reports. As the result of a survey made by N.E.M.A., and covering two-fifths of the industry, it is evident that, contrary to general opinion, companies employing 50 or less men report the greatest advances, not only in employment but in sales and profit as well.

The data on which the report was compiled were based on returns received by N.E.M.A. in response to the questionnaire sent out in March. The information was supplied by 119 companies and represented more than 40 per cent of the industry's volume of business.

The employment figures for manufacturers employing under 50 workers are 19 per cent above the level of July, 1929, and nearly one-half larger than in February, 1933. Manufacturers employing from 50 to 199 men show the index of employment is 83 per cent of the July, 1929, level, a gain of 40 per cent over February, 1933. Plants employing from 200 to 499 men show an improvement of 33 per cent over February, 1933. Plants of 500 to 999 employees show a gain of slightly over 40 per cent, while the larger plants of more than 1,000 men show a gain of but 23.7 per cent over February, 1933.

Smaller companies show sales gains

In sales, the smaller companies show a larger gain proportionately than the middle-section groups and decidedly more than the largest companies, which have actually gone backward during the last two years. Sales for the manufacturers employing 50 or fewer men have an index of 53 per cent of 1929 sales, which is 43.24 per cent increase on their 1932 sales and 20.5 per cent better than their 1933 sales figures. The manufacturers employing 50 to 199 men and 200 to 499 men show sales improvement of only 6 per cent and 2.5 per cent, respectively, for 1934 over 1932. Manufacturers in the 500 to 999 men class show an improvement of 25 per cent in sales over 1932, while the companies employing 1,000 men or more show a decline in sales to 27 per cent of their figures for 1929, as contrasted with 26 per cent for 1933 and 31 per cent for 1932.

Large companies lag in profits

"The smaller companies did not lose as much ground in the depression as the larger companies and are recovering more rapidly than the latter," the report states. "The last two groups in particular remain consistently worse off than the others, and the largest companies which were lower in 1933 than in 1932 seem scarcely to have turned the corner even in 1934. The most significant shift is in the relative positions of the group of the smallest companies from the least favorable with regard to profit in 1929 to the most favorable in 1933 and in the beginning of 1934. These smallest manufacturers alone reported profits in 1933, and for the beginning of 1934 they had a rate of profit actually greater than that of 1929. The manufacturers employing from 50 to 199 men and those employing from 200 to 499 men have been the most consistent throughout the period and today the latter group seem somewhat better off than the former. The groups employing upward of 599 and 1,000 men have been the most irregular; the largest companies, apparently strongest in 1929 and in 1932, having slipped to second place in 1933 and to the lowest during the beginning of 1934.

"If any conclusion is to be drawn, outside of the statement of the figures themselves," the report says, "it might be that the smaller manufacturers of the electrical industry are in a better relative position today, and the frequently heard assertion that NRA works to oppress the small business man is unfounded in what appears to be the facts."

NRA May Impose Telegraph Code

Restrictions cover rates and wire leasing. New hours, wages fixed. Hearing set for May 16.

His earlier decision to force a code on the telegraph industry was termed only possible by Gen. Hugh A. Johnson late this week. This action, following unsuccessful efforts to get the industry to submit a code of its own, marks the first attempt on the part of the Recovery Administration to impose a code on an industry through Presidential action. Hearings on the code have been called by General Johnson for May 16.

The code specifically names the Western Union, Postal Telegraph, American Telephone & Telegraph and the Radio Corporation of America as members of the industry. It includes all their affiliates and subsidiaries, but only to the extent that they are engaged in the telegraph business. The telephone business is not affected by this code.

These four companies are to have one representative each on a ten-man Code Authority. General Johnson would have power to appoint three voting members and three Administration members without vote. Chief among the fair trade practices provisions is one requiring all members of the industry to file with the Interstate Commerce Commission reports showing all rates of charges both over their own facilities and over joint facilities. Another provision bars the use of multiple circuit leases under which, it is alleged, the A.T.&T. obtains an unfair advantage by allowing a lessee of a "leased" circuit to sublet.

The code would establish a forty-hour maximum work-week throughout the industry as against the forty-eight-hour week temporarily authorized under the substitute President's Re-employment Agreement and in the code agreed upon in September. Minimum wage rates ranging from $15 weekly in cities of more than 500,000 population to $14 a week in cities, towns and villages of less than 250,000, with a $1 differential in the South, would be fixed by the code. It also specifies a minimum of $10 a week in the North and $9 weekly in the South for messengers.

COMING MEETINGS

National Fire Protection Association—Atlantic City, N. J., May 14-18. A. R. Small, 109 Leonard St., New York.

American Institute of Electrical Engineers—Northeastern District meeting, Worcester, Mass., May 16-18. Summer convention, Hot Springs, Va., June 25-29. H. H. Henline, 33 W. 39th St., New York.

Northwest Electric Light and Power Association—Engineering and Operation Section, annual meeting, Portland, Ore., May 17-19. Berkeley Snow, 707 Spalding Bldg., Portland, Ore.

National Electrical Manufacturers Association—The Homestead, Hot Springs, Va., May 21-24. A. W. Berresford, 155 East 44th St., New York.

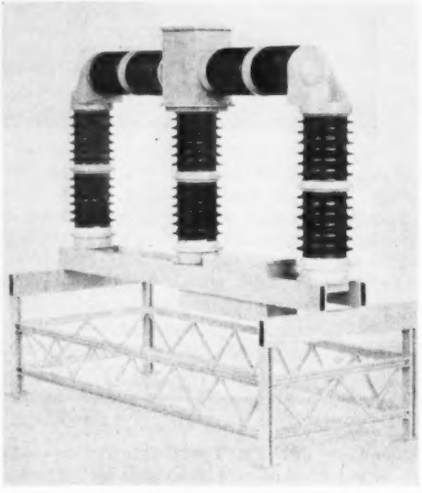
Edison Electric Institute—Atlantic City, N. J., June 4-7. B. F. Weadock, 429 Lexington Ave., New York.

Canadian Electrical Association—Annual convention, Seigniory Club, P.Q. (Lucerne-in-Quebec), June 13-15. B. C. Fairchild, 409 Power Building, Montreal, Que.

Public Utilities Advertising Association—Annual convention, New York City, June 17-20. Eric W. Swift, Commonwealth Edison Company, Chicago, Ill.

American Society of Mechanical Engineers—Semi-annual meeting, Denver, Col., June 25-28. Calvin W. Rice, 29 W. 39th St., New York.

Impulse Breakers for 287-Kv. Boulder Dam Line



A radical departure in high-voltage impulse oil circuit breakers is incorporated in the eight breakers ordered this week from the General Electric Company for use on the 287,000-volt transmission lines from Boulder Dam to Los Angeles. The breakers wil have an interrupting rating of 2,500,000 kva. and will have a rated opening time of 3 cycles. The fastest hitherto available for high voltages have been rated 8 cycles.

Known as type FG-30 the breakers will weigh less than the oil alone in breakers now installed on 220,000-volt lines. They will require approximately 1,000 gal. of oil each, compared with about 23,000 gal. for 287,000-volt breakers if built according to conventional tank design.

Novel in appearance, each pole of the breaker resembles a letter E turned on its side. The conductors will connect to the ends of the horizontal member which contains eight sets of contacts in series. The oil pistons are in the boxes at the top of the center vertical posts. A motor-wound spring-operating mechanism is in the housing at the foot of this post. The two outer posts contain current transformers and potential taps.

British Split-Hair Wire

Manufacture of wire of a diameter of two one-thousandths of an inch has been announced by the British Insulated Cables, Ltd. This wire is finer than a human hair and a pound of it has a length of fifteen and one half miles.

——THIS WEEK IN WASHINGTON

House votes approval of Johnson bill . . . Agreement seen for communications code . . . Municipal plants to conform to light and power code.

THE House this week passed the Johnson bill, closing federal district courts to public utility rate contests. The vote was 219 to 19. The measure now goes back to the Senate for approval of a minor amendment which would prevent federal district courts from acting on appeal from "rate-making bodies of any political subdivision" of the United States. Appeal would be permitted only from state courts to the United States Supreme Court. Debate in the House on the bill was particularly bitter. Representative Beck of Pennsylvania characterized it as the entering wedge that would result in the destruction of the federal courts. Representative Lloyd of Washington said the substitute measure, supported by a majority of the House judiciary committee, was sired by reaction.

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Despite claims to the contrary, the prevailing opinion in Washington is that an agreement will be reached as to a code for the communications industry. The controversy over this code has added greatly to the interest in the public hearings May 16, at which differences will be discussed. (See this issue, first column.)

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All difficulties are said to have been ironed out in a final draft of the electric light and power code. As this is written, the code is under final review by Donald Richberg, NRA chief counsel. President Roosevelt's assurance that all publicly owned plants will have to conform to wage and hour provisions of the code has reassured the industry.

PAUL WOOTON,
Washington Correspondent.

"Electricity at Work" to Return to 1934 Fair

An expanded "Electricity at Work" exhibit will feature the display of the electric light and power industry at the 1934 Century of Progress Exposition, opening May 26. Most of the 1933 attractions will again be shown at Chicago.

Among the new features will be an electrical puppet show performing in an air-conditioned theater, an electrical workshop in which daily demonstrations of woodworking will be given, an air-conditioning display, and an enlarged industrial display. Popular features of 1933 to be retained will include the 90-ft. diorama, depicting a completely electrified city and its surrounding countryside, the model operating room, restaurant, beauty shop and stores with their miniature inhabitants and multitude of electrical conveniences. The electrical kitchen will feature labor-saving appliances for the housewife.

Industrial Demand Boosts March Output

Geological Survey reports 15% increase over 1933 figure. New England and Atlantic states show largest gains.

Overshooting every month since the end of 1931, the output of public utility plants in March ran up to 7,665,000,000 kw.-hr. According to the U. S. Geological Survey, it exceeded production a year ago by 15 per cent. It almost matched that of the same month in 1931 and missed the March record set in 1930 by only 6 per cent. It was unusual in surpassing the output of the preceding winter months when the lighting load is largest.

Compared with February, there was a decrease of 1.2 per cent. This is reckoned on the basis of average daily production, to take into account the difference in length of the two months. This was less than the normal change, which is a decrease of 1.7 per cent. The Survey figures comprise the output of central stations, including municipal, of plants operated by electric railways, and of the Bureau of Reclamation, public works and that part of the output of manufacturing plants which are sold.

Hydro production rises

The average daily production of electricity by the use of water power was 19 per cent larger than in February. All but two or three states showed an increase in production from this source. The output by the use of fuel was 12 per cent less than in February, with a corresponding decrease in the amount of fuel used.

The gain over 1933 was especially large in the East North Central states, New England and the South Atlantic division. In each of these regions it approached or exceeded 25 per cent. Changes, in per cent, from 1933 for the various parts of the country, with comparative figures for January and February, were as follows:

Region	Jan.	Feb.	Mar.
New England	+16	+22	+24
Middle Atlantic	+ 9	+14	+12
East No. Central	+18	+20	+27
West No. Central	— 5	0	+ 2
South Atlantic	+ 4	— 3	+ 8
East So. Central	+18	+28	+23
West So. Central	+12	+ 5	+ 9
Mountain	+20	+14	+15
Pacific	+ 4	+ 7	+ 8
United States	+10	+12	+15

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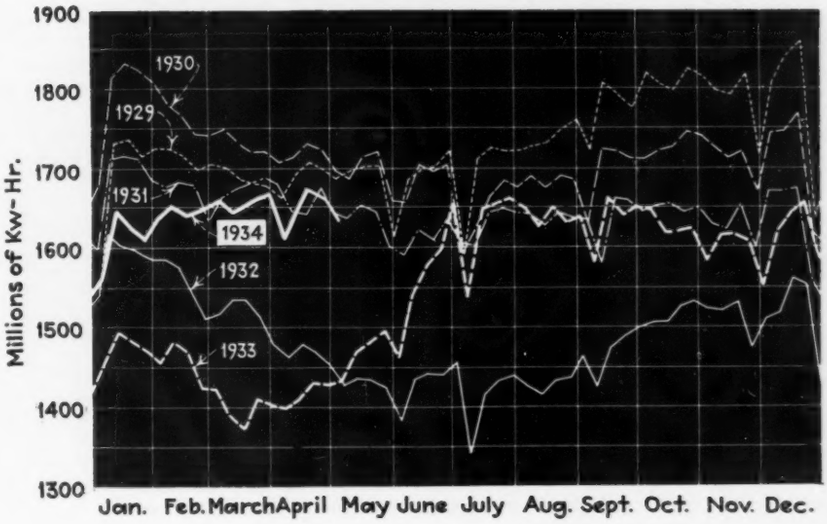
British Grid Completed

Initial construction on England's national grid network is accomplished, according to the sixth annual report of the British Central Electricity Board. As finally constructed, the network includes approximately 4,000 miles of transmission lines. About 3,000 miles is operated at 132 kv. and the remainder at 66 kv. or less. By April 1, 1934, the report states, general trading was being carried on by the Central Electricity Board in six areas containing 77.8 per cent of the population and 84.3 per cent of the energy consumption of the United Kingdom.

Enter Daylight Saving



The resumption of daylight-saving time brought a moderate reduction in central station output. Production in the week ended May 5 was 1,632,766,000 kw.-hr., according to the Edison Electric Institute. This was 2.1 per cent less than in the preceding week but there remains a gain of 13.7 per cent over 1933 and of 14.3 per cent over 1932. Output was only 3.9 per cent less than in the week of May 3, 1930, the year of maximum spring activity. As has been the case during the past few weeks, the figures are close to those of the year 1931.

In the Eastern and Central industrial area the increase over 1933 was somewhat smaller than it has been lately. The same is true of the South, which, with 6.5 per cent, shows the least gain compared with last year and the largest recession from the previous week. The West, on the contrary, reports increasing progress.

Weekly Output, Millions of Kw.-Hr.

1934	1933	1932
May 5...1,633	May 6...1,436	May 7...1,429
Apr. 28...1,669	Apr. 29...1,428	Apr. 30...1,455
Apr. 21...1,673	Apr. 22...1,431	Apr. 23...1,470
Apr. 14...1,642	Apr. 15...1,410	Apr. 16...1,481
Apr. 7...1,617	Apr. 8...1,399	Apr. 9...1,465

Per Cent Change from Previous Year

Region	Week ended May 5	Apr. 28	Apr. 21
New England	+13.0	+16.7	+15.7
Middle Atlantic	+10.2	+12.3	+13.3
Central Industrial	+16.3	+22.6	+22.4
West Central	+ 6.5	+10.6	+11.2
Southern States	+11.5	+17.2	+16.5
Rocky Mountain	+26.8	+25.2	+20.4
Pacific Coast	+15.3	+12.5	+13.3
United States	+13.7	+16.8	+16.9

Sub-Frequency Converter Developed in India

A new type of converter for transforming three-phase current into single phase of sub-multiple frequency has been developed in the Indian Institute of Science at Bangalore. Experiments were carried out during the past year in the Department of Electrical Technology by Prof. F. N. Mowdawalla and P. K. Kelhar. The machine has an armature similar to a d.c. armature, provided in addition with slip rings through which three-phase power is fed. The field system is laminated and may be designed for either single-phase or polyphase currents. The exciter is direct coupled and has the same number of poles as the main machine. It will synchronize at half synchronous speed, when the exciting windings carry half frequency currents, and half frequency single-phase output can be obtained from commutator brushes 180 electrical degrees apart. In spite of the single-phase output, the currents drawn from the mains are balanced and power factor can be varied or kept at unity under varying load.

Preliminary experiments indicate that the machine can work with high efficiency and there is no sparking at the commutator. Outputs of other sub-multiple frequencies can be obtained by suitably selecting the number of poles of the exciter. Polyphase outputs can also be secured by using a suitable number of brushes.

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Electrical Fire Loss Cut

Fires traceable to the misuse of electricity have been reduced in the past three years from approximately $15,000,000 to $11,800,000. The National Board of Fire Underwriters announced these figures last week. The decline in fire loss was due in no small measure to the efforts of electrical cord manufacturers and other industry groups and to the "Identified Cord" movement.

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U. S. Switch Specifications

Proposed specifications for multiple type and single unit snap switches have been distributed for manufacturer or producer comment by the Federal Specifications Board, Washington. Criticism or comment must be filed with the board before June 27.

As to Rates . . .

Public Service Company of Northern Illinois electric rates were slashed $1,300,000 a year in a temporary order of the Illinois Commerce Commission handed down last week. Reductions were ordered in service to residential and commercial users and in rates for municipal street lighting, the reductions ranging from 8 to 15 per cent. Reductions to residential users will average approximately 11.8 per cent to some 228,675 customers and will aggregate a saving of approximately $1,055,000. The lower rates were ordered pending the completion of an investigation now being conducted by the commission to determine permanent rates. In its order the commission allowed an electric rate base of $134,500,000, as against its attorneys' contention of not more than $125,000,000 and the company's contention of not less than $150,000,000. Rate of return was set at 6.3 per cent. The commission's attorneys contended during hearings on the case that 6 per cent was reasonable and the company contended it should have 7 to 7.5 per cent.

Significance of order

In the opinion of attorneys for the commission the order is one of the most important and far-reaching decisions ever handed down in the twenty years' history of public utility regulation in Illinois. In a statement commenting on the order the attorneys said: "While the order is of great importance to the state, in that it provides for the first ordered rate reduction under the power given to the commission to enter temporary rate orders, it is of at least equal significance in that it carries with it the establishment and declaration of fundamental principles of regulation which should have great influence on the course of future regulation of public utilities in Illinois. Of first importance is the fact that the commission has declared that it will not permit utilities to place the burden of their financial mistakes upon the rate-payers by getting more than a fair rate of return. Other principles laid down are that original cost is to be given great weight in determining fair value, that the commission will attach no weight to conjectural or hypothetical theories, that utilities must establish the propriety of their operating expenses, and many other principles, some of which have never before been enunciated by this commission . . ."

Utility accepts cut

The Public Service Company will accept the temporary cut ordered. James Simpson and George A. Ranney, chairman and vice-chairman, in a statement following the announcement of the rate reduction, expressed the expectation that the commission will make the order permanent, despite the fact that "we consider the terms most severe and not justified." The statement continued: "If this case were taken to the federal courts by injunction proceedings, it would mean interminable delay, disturbed public relations and further heavy expenses, all to be borne by the owners of the business. Notwithstanding the inequities of the commission's findings, the company, deeming it wise to avoid further lengthy and expensive hearings and court proceedings, has adopted the rate reductions imposed by the commission, believing that, in view of its public statement, the commission will see fit to make the temporary order a final order. The company's staff will thus be relieved from devoting their time and energy to defending our rate structure before the commission and federal court and will be enabled to address themselves to the development and expansion of the consumption of electrical energy and gas in the growing territory served by the company."

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Utah Power & Light Company, in a reply brief filed with the state Utilities Commission, contends that rates charged for electricity furnished to Fort Douglas are not excessive and that benefits received from service fees paid to the Electric Bond & Share Company far outweigh the cost involved. The brief was filed in connection with the case of the United States army against the power company, seeking a 10 per cent reduction in electrical rates at the military post. Inasmuch as these services are charged in accord with rate schedules which also affect the general consuming public, the complaint of the army assumed considerable importance and the hearing before the commission attracted wide attention. The attorneys for the company contend that even if the deflated value of the property, as found by the Federal Trade Commission's investigators, were used, the company's rate of return would be found to be considerably below what it might reasonably expect to be allowed to earn, and that therefore its rates are not unreasonable. Discussing its payment of service fees, the company claimed it receives expert assistance in the engineering, accounting, legal, merchandising, financing, rates and research fields —services which, if not secured from the Electric Bond & Share Company, would have to be purchased through other agencies.

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Dayton Power & Light Company has lost in the U. S. Supreme Court its fight against the Ohio Public Service Commission orders which refused to allow it to increase its rates in accordance with a schedule filed June 17, 1929.

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Grays Harbor Railway & Light Company rates and valuations were discussed at a recent hearing before the state Department of Public Works at Olympia, Wash. V. C. Klug, department accountant, testified that the Federal Light & Traction Company has a 2 per cent interest advantage over the Grays Harbor company, a subsidiary. He stated that when money was due the parent company from the Grays Harbor company, Federal Light charged 6 per cent interest on unpaid balances, but when the parent company owes money to its subsidiary it pays only 4 per cent. In tracing the Grays Harbor Company's financial history Mr. Klug said it is controlled through common stock ownership by the Federal company, which in turn is controlled by the Cities Service Power & Light Company, subsidiary of the Cities Service Company.

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Loan Sought by Fort Worth

The possibility of a municipally owned power and light plant for Fort Worth, Tex., arose again with the announcement by the Public Works Administration that it had permitted this city to apply for a $2,228,000 loan for the construction of a plant on order of Secretary Harold Ickes. The application previously had been rejected because it was filed after the deadline on February 12.

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Ban Installment Plants

The Ohio Supreme Court has ruled that the contract entered into between the village of Brewster and Fairbanks, Morse & Company is invalid. Under this agreement this manufacturer would furnish equipment for a municipal electric light plant on deferred-payment terms. The decision, upholding a previous ruling of the Court of Appeals, held that such a contract contravened the Ohio Constitution.

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$120,000 Program Delayed

Circuit Court in Goshen, Ind., has granted a temporary restraining order to prevent officials of that city from proceeding with the $120,000 electrification program for the city water works. Defendants are the Mayor and members of the Board of Public Works. The city's application for a P.W.A. loan of $120,000 to finance the project has been approved and a bond ordinance passed. The city had planned to start work immediately.

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Camden Hearing Set

Request by the Public Service Electric & Gas Company for dismissal of a review of a referendum petition on the municipal electric light plant in Camden has been refused by the state Supreme Court. The court fixed the hearing date for September 10.

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Bond Issue Loses in Lodi

Proposal to bond the city of Lodi, Calif., for $520,000 to build a hydro-electric plant on the Mokelumne River lost at the recent special election by 968 for and 674 against. A two-thirds vote was required.

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City Plant Motion Tabled

Iowa City Council has voted to table a motion to enforce the construction of a municipal light and power plant. Council took this action despite the fact that voters have approved of this undertaking at a cost of $917,000 (ELECTRICAL WORLD, April 28, page 634).

FINANCIAL · · · BUSINESS

Shareholders Warned in O'Brien Report

Standard Gas & Electric head asks investor protest against government competition and interference. Net earnings decline.

An earnest plea for freedom from governmental interference and competition for privately operated public utility companies was made last week by John J. O'Brien, president of the Standard Gas & Electric Company. In the annual report of his company, covering 1933 operations, Mr. O'Brien pointed to the future facing utility companies.

John J. O'Brien—"Public utilities are entitled to protection from destructive competition."

"During depressed years they met declining revenues with rigid economies," he said, "but now, with business only slightly improved, operating costs greatly increased by compliance with the National Recovery Administration codes, and rates strictly controlled by state and local regulation, they are faced with direct competition from the very government they help to support with the heavy taxes they are compelled to pay.

"We present these facts to our shareholders because we feel that every investor in public utility securities should be acquainted with the situation.

Asks for investor action

"We believe the public utilities are entitled to protection from destructive competition since all of their operations already are under comprehensive public regulation, and also from an unduly heavy burden of taxation, and that investors in public utility securities, in their own interest, should acquaint their regularly elected representatives with the facts respecting those unfair governmental policies, whether local, state or national, which tend to destroy the value behind these investments which have such a wide diffusion of ownership among the American people."

Net earnings of Standard Gas subsidiary and affiliated companies in 1933 were $58,528,988, compared with $63,384,217. Consolidated net income amounted to $2,459,965 for 1933, equal to $5.41 and $4.64 a share, respectively, on the $7 and $6 cumulative prior preference stocks of the parent company, comparing with $7,720,640, or 62 cents a share, on 2,162,607 common shares, earned in 1932.

The balance sheet at December 31 shows current assets of $49,029,588, including $24,221,222 cash, and current liabilities of $34,891,091, including $8,370,300 bank debt.

Major conversion planned

A projected financing of around $25,000,000 to meet 1935 maturities approximating $24,600,000 is receiving consideration. If the plan is brought to public offering it will be the second major borrowing in the corporate field since the securities act went into effect last July. In March American Water Works & Electric financed with eminent success its $13,500,000 maturity of collateral 5s with an offering of $15,000,000 convertible collateral 5s, 1944. The Standard Gas maturities comprise $14,800,000 20-year 6s and $9,800,000 convertible 6 per cent notes due October 1, 1935.

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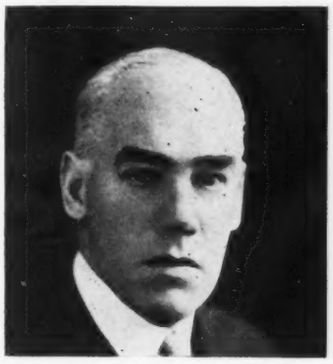
Zimmermann Sees Menace to Utility Investors

"The time has come when utility investors must actively interest themselves in the protection of their property," President John E. Zimmermann told stockholders of the United Gas Improvement Company at their annual meeting this week.

"We are threatened with government ownership, with governmentally financed competition, with demands for rate reductions unwarranted in the face of increased costs and taxation imposed by governmental edict," he said. "For the wrongful acts of a few men an entire industry is attacked and the value of sound securities threatened.



John E. Zimmermann—"Investors must interest themselves in protection of their property"

"These are the problems of the immediate future vitally affecting the investment of the great army of savers and utility security holders in this country."

The company has continued to pay the dividend of $1.20 a share annually on its common stock, Mr. Zimmermann stated. An estimate of this year's earnings, he said, indicated the equivalent of slightly more than the amount of dividend paid.

MODERATION

Facing a new crisis in the affairs of NRA, the Administration appears more than willing to adopt a policy of moderation. It is politically committed to continued reform and regimentation, but nevertheless recognizes that business and not government must sustain the activities on which ultimate recovery depends. Somewhat startling shake-ups appear probable following the refusal to meet silver-inflation importunities. The great credit reserve now existing offers promise of sufficient inflationary effect to satisfy all but the wildest of New Dealers. That credit runaway-curbs have been generously provided is encouraging if not necessarily convincing.

Figures of the week continue, in the main, quite satisfactory. Bituminous coal production, carloadings, steel activity, all up. Electrical energy output, automobile production, textile activity and retail sales off. Commodity prices in appreciable rally. Bonds fairly steady. Stocks notably soft in continuation of two-week decline.

Westinghouse Sales Drive

A peak season refrigerator sales drive has been launched by the Westinghouse Electric Company with its new "C" line of "Master" series refrigerators. Twelve models are included, five with porcelain finish and seven with an improved lacquer finish. Several convenient or attractive features have been added, including refrigerated upper shelves for quicker freezing in the larger models.

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Community Power to Have Stone & Webster Direction

Supervision of the Community Power & Light Company, a holding company controlling public utilities in Arkansas, Kansas, Missouri, Texas and other points in the south and southwest, has been assumed by the Stone & Webster Service Corporation of New York. The new contract is for one year, expiring on April 16, 1935. Gross earnings of the operating subsidiaries of Community Power & Light total approximately $3,700,000 annually.

U.S. to Survey Equipment Markets

Department of Commerce investigation intended to reveal areas now undeveloped by electrical equipment manufacturers.

A comprehensive survey of markets now being lost to electrical equipment manufacturers is planned by the Bureau of Domestic and Foreign Commerce of the Department of Commerce. The study, announced last week, will be based upon findings of the real property survey by the same department, now nearing completion. The new study is expected to require at least two months' time.

A number of undeveloped markets for electrical appliances throughout the country will be revealed by the investigation, according to Andrew W. Cruse, chief of the electrical equipment division. The study will cover the 65 cities and towns included in the real property survey. Mr. Cruse plans to use the real property figures on electric lighting, cooking and refrigeration, and to compare the percentage of such equipment in the towns surveyed with existing power rates. The purpose of the survey is not to develop the relation of power rates to the amount of electrical equipment in homes, Mr. Cruse emphasized.

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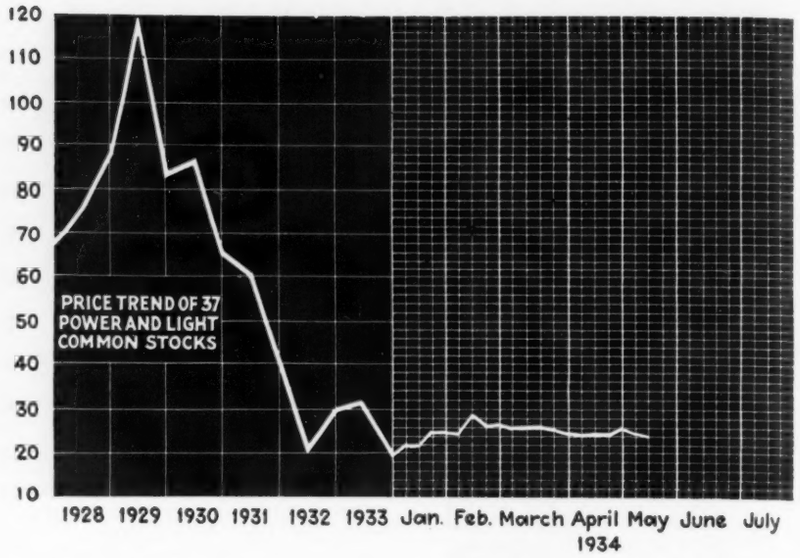
Associated Plan Upheld

A permanent injunction restraining the State of Iowa from interfering with the reorganization plan of the Associated Gas & Electric Securities Company, Inc., of Delaware has been granted by Federal Judge Dewey in Des Moines, Iowa.

Utility Shares in Sharp Decline



Electric light and power company common shares, following the broadest general market decline of the year, this week brought the *Electrical World* index to 23.8; last week it stood at 24.8.

Gary Electric Seeks Bond Extension to 1944

Unable to meet $8,000,000 of first lien bonds maturing July 1, Gary Electric & Gas Company announced this week a plan for extension of the issue to July 1, 1944. As announced by John N. Shannahan, chairman, the plan calls for maintaining interest at the annual rate of 5 per cent. The bonds are the company's only funded debt.

In addition to extended bonds, all bondholders who assent to the plan will receive a share in the equity of the company equal to their proportionate share of 25 per cent of the outstanding common stock. July 1 interest coupons will be paid immediately upon receipt of bonds deposited under the plan and the company will set up a sinking fund each year of the first $100,000 earned above interest charges and 25 per cent of all other earnings, Chairman Shannahan's letter states.

Current Earnings Reports of Electric Light and Power Companies

Operating Companies

	1934	1933	Per Cent Increase	Operating Ratio 1934	Operating Ratio 1933
Alabama Power (Year ended March 31)					
Gross earnings	$15,632,893	$15,199,974	2.8	49	48
Net earnings	7,890,566	7,915,195	— 0.3		
Net balance	847,759	940,429	— 9.8		
Commonwealth Edison (Year ended March 31)					
Gross earnings	73,684,478	72,264,535	1.9	80	78
Net earnings	14,943,524	15,825,286	— 5.5		
Net balance	7,372,451	8,784,959	— 16.0		
Consumers Power (Year ended March 31)					
Gross earnings	26,443,875	26,795,624	— 1.3	56	53
Net earnings	11,738,827	12,564,514	— 6.7		
Net balance	3,021,753	3,839,104	— 21.3		
Connecticut Light & Power (Year ended March 31)					
Gross earnings	15,135,326	14,752,973	2.6	58	57
Net earnings	6,387,449	6,330,306	0.9		
Net balance	3,516,689	3,392,185	3.7		
Georgia Power (Year ended March 31)					
Gross earnings	22,285,217	21,857,148	1.9	51	48
Net earnings	10,989,434	11,256,572	— 2.4		
Net balance	1,917,600	2,116,646	— 9.4		
Kansas City Power & Light (Year ended March 31)					
Gross earnings	14,325,961	14,666,253	— 2.3	60	58
Net earnings	5,709,117	6,252,913	— 8.7		
Net balance*	3,252,202	3,734,080	— 12.9		
New York Edison (Year ended March 31)					
Gross earnings	64,818,904	68,251,528	— 3.5	77	71
Net earnings	15,099,833	19,494,893	— 22 6		
Net balance	20,495,825	25,073,551	— 18.3		
Philadelphia Electric (3 mos. ended March 31)					
Gross earnings	16,629,658	16,177,452	2.8	50	49
Net earnings	8,276,010	8,230,795	0.5		
Net balance	5,646,590	5,604,344	0.7		
Southern California Edison (Year ended March 31)					
Gross earnings	35,286,646	36,175,679	— 2.0	36	32
Net earnings	22,432,553	24,685,987	— 9.0		
Net balance*	15,123,913	17,477,859	— 13.0		
Tennessee Electric Power (Year ended March 31)					
Gross earnings	11,663,364	11,328,728	2.9	60	58
Net earnings	4,614,594	4,791,858	— 3.7		
Net balance	414,510	581,151	— 28.5		

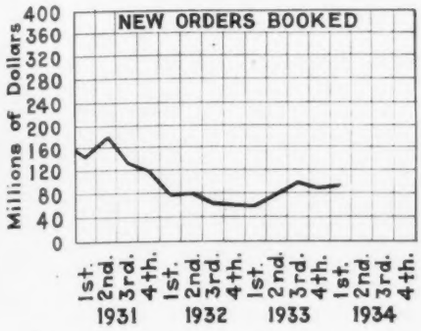
Holding Companies

	1934	1933	Per Cent Increase	Operating Ratio 1934	Operating Ratio 1933
Commonwealth & Southern and subsidiaries (Year ended March 31)					
Gross earnings	110,935,740	110,384,715	0.5	56	54
Net balance	9,734	1,450,389	— 99.0		
Electric Bond & Share (Year ended March 31)					
Gross earnings	14,423,530	16,936,349	— 14.8		
Net balance	2,073,095	3,575,466	— 42.0		
North American Company and subsidiaries (Year ended March 31)					
Gross earnings	106,435,539	110,234,739	— 3.4	65	63
Net balance	9,678,832	12,144,629	— 20.3		

*Applicable to all dividends.

Gross earnings—(Operating Companies) Gross operating revenue. (Holding Companies) Gross operating revenue plus other income. Net earnings—Earnings after deduction from gross earnings of operating expenses taken to include taxes, depreciation, maintenance, operating, etc. Net balance—Balance available from income for common stock dividends.

Electrical Manufacturing Orders Rise for Quarter



New orders booked by 78 manufacturers of electrical goods reversed the decline of the last 1933 quarter (ELECTRICAL WORLD, February 17, page 277) and increased approximately 10 per cent in the first three months of 1934. The volume booked for the first quarter, as reported by the Bureau of the Census, was $92,133,637. This compares with $88,544,234 in the last 1933 quarter and $57,897,333 for the first quarter of 1933. The total includes motors, storage batteries, domestic appliances and industrial equipment. Preliminary and unofficial figures indicate that this general improvement in the first quarter is being carried forward through the second three months.

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Manufacturers Report Increased Profits

First quarter reports of manufacturers of electrical equipment and appliances issued this week show marked increases in profits for the first quarter of 1934.

Anaconda Wire & Cable Company reports profit after depreciation, obsolescence and other charges, but before taxes, of $154,181, against $181,757 for the same 1933 quarter.

Net profit of Radio Corporation of America for the first quarter amounted to $1,235,725 compared with a loss of $478,164 in the 1933 period, and $24,448 more than the profit for the final quarter of 1933, normally the most profitable period of the year. Gross income from all sources amounted to $19,133,919, comparing with $13,222,054 in the first quarter of 1933, a gain of 45 per cent.

Eureka Vacuum Cleaner Company shows net profit after taxes, depreciation and other charges of $66,038, equal to 27 cents a share on 244,918 $5 per capita shares, compared with $944, or less than a cent a share in the first quarter of 1933.

Black & Decker Manufacturing Company has net profit for the six months ended March 31, of $110,671, and, according to President S. D. Black, the company's business has shown a progressive increase during each of the six months in the fiscal year.

Jefferson Electric Company shows net income for the year 1933 before special charges of $152,856, contrasting with a loss of $109,251 in 1932. Earnings for 1933 amounted to $1.27 a share on 120,000 shares of common stock.

Maytag Company reports consolidated net profit, after depreciation, taxes, etc., of $460,381 for the first 1934 quarter, contrasted with a deficit of $95,165 for the same 1933 period. Net sales for the three months of 1934 were $4,059,293, comparing with $755,287 for the same quarter last year.

New York Metal Prices

	May 1, 1934 Cents per Pound	May 8, 1934 Cents per Pound
Copper, electrolytic	8.50*	8.50*
Lead, Am. S. & R. price	4.25	4.25
Antimony	7.95	8.70
Nickel ingot	35.00	35.00
Zinc, spot	4.75	4.70
Tin Straits	55.25	54.00
Aluminum, 99 per cent.	23.30	23.30

*Blue Eagle

SALES OPPORTUNITIES IN NEW CONSTRUCTION

Spot coverage of the week. Projects approved and proposed, bids requested, equipment wanted, funds available. Prospects for the electrical manufacturer.

Hopedale, Mass. — Draper Corporation will install motors and controls, regulators, conveyors, electric hoists, etc., in new multi-story addition to textile machinery manufacturing plant. Cost over $400,000.

California, Mo.—Asks bids until May 21 for equipment for new city-owned electric light and power plant, including Diesel engine-generating sets, fuel storage and distribution system, switchboard and instruments and complete accessories; also for electrical distribution and street-lighting system, including poles, wire and cable, transformers, etc. Fund of $145,000 has been arranged.

Kalamazoo, Mich.—Allied Paper Mills, Inc., will install motors and controls, conveyors, regulators for expansion and improvements at King Division Mill, to double present capacity. Cost about $200,000.

Fresno, Calif. — Kingsland Granite Company soon purchases heavy-duty motors and controls, electric hoists, drills, conveyors, loaders, etc., for new plant and mill near Madera, Calif. Cost about $150,000 with machinery.

Moberly, Mo. — Has called special election June 5 to approve bonds for city-owned electric light and power plant, totaling $700,000, installation to include two 2,000-kw. generating units, two watertube boilers and complete accessories.

Loretto, Ky.—Buck Springs Distilling Company, L. C. Roberts, head, recently organized, plans extensions and improvements in former local Buck Springs Distillery. Cost about $50,000 with equipment.

Memphis, Tenn.—Memphis Power & Light Company plans new transmission line along Jefferson Davis Highway to Millington, Tenn., and vicinity; also new underground conduit lines from power plant to power substation, Memphis. Cost about $60,000.

New York, N. Y.—Titanium Pigment Company has authorized plans for power plant at new works, consisting of eleven buildings, at Sayreville, N. J., for which foundations will soon begin. Motors and controls, conveyors, electric furnaces, electric pumping machinery, etc., will be installed for production service. Cost over $1,500,000 with equipment.

Chicago, Ill.—Arcady Farms Milling Company plans installation of motors and controls, hoists, conveyors, screens, etc., in connection with rebuilding of grain and feed elevator, recently destroyed by fire. Loss about $100,000.

Oklahoma City, Okla.—Oklahoma Gas & Electric Company is considering new transmission line to oil field district, near Crescent City, Okla., making connection with system at Guthrie, Okla.

Milford, Iowa — City asks bids until May 28 for equipment for electric light and power plant, including Diesel engine-generating sets, exciters and accessory equipment, switchboard and instruments; also at same time for electrical distribution system, including poles, wire and cable, transformers, etc. Fund of $70,000 is available.

Philadelphia, Pa.—Crew-Levick Company plans expansion and improvements in oil refining plant at Titusville, Pa. Cost about $200,000 with electric and other equipment.

Iowa City, Iowa — Plans early construction of city-owned electric light and power plant. Fund of $917,000 has been authorized.

Knoxville, Tenn.—Tennessee Valley Authority plans transmission line over Elk River, near Sugar Creek, Limestone County, Ala., in connection with new Wilson Dam-Norris Dam transmission line. Application made for permission.

New Haven, Conn.—New Haven Pulp & Board Company plans installation of motors and controls, conveyors, etc., in new multi-story addition. Cost about $60,000.

Boston, Mass.—Has secured fund of $88,500 through federal aid for extensions and improvements to municipal police department communication system.

Independence, Iowa—Plans extensions and improvements in city-owned electric light and power plant, including installation of 500-kw. Diesel engine-generator set. Estimates of cost being made and financing arranged.

Tacoma, Wash. — Independent Ice & Cold Storage Company plans new multi-story brewing plant, capacity about 500 bbl. per day. Cost $100,000 with equipment.

Seaford, Del.—Has engaged Frank J. Glueck, Philadelphia, Pa., engineer, to make surveys and estimates of cost for proposed city-owned electric light and power plant.

Niagara Falls, N. Y.—American Treibach Chemical Works, Inc., recently organized, plans installation of motors and controls, regulators, electric furnace equipment, conveyors, etc., in new local plant on Highland Avenue. Cost over $100,000. Larger plant unit will be built in future to cost in excess of sum noted.

MEN OF THE INDUSTRY

Donald Managing Director of Nema; Berresford Resigns

A. W. Berresford has resigned as managing director of the National Electrical Manufacturers Association. J. S. Tritle, president of Nema, regretfully announced the resignation on Saturday. Mr. Berresford, who has been long prominent in the counsels of the

industry and for five years has guided the activities of Nema, has announced no plans. He will be succeeded by W. J. Donald.

Mr. Donald is not an electrical man, but has had long experience in industry organization. For more than ten years he was managing director of the American Management Association and helped build its membership from 100 to nearly 5,000. Since the coming of NRA he has been active as a consultant to trade associations and engaged in the reorganization of associations and in code administration. He comes to Nema from the Packaging Machinery Manufacturers Institute, where he was executive vice-president and treasurer. The institute was organized under his direction as a code authority.

Mr. Donald has also been executive vice-chairman for the Code Authority for the canning and packing machinery and equipment industry; secretary-treasurer of the Canning and Packing Machinery Institute and code counsellor for the Industrial Safety Equipment Association. He assisted in preparing the supplemental code for the can labeling and can casing industry and for the paper box machinery industry and trade.

He is a graduate of McMaster University in Canada and holds a Ph.D. in economics from the University of Chicago. He is a member of the American Management Association (vice-president), American Economic Association, American Society of Mechanical Engineers, American Statistical Association, American Trade Association Executives, Trade Association Executives of New York, Bankers Club of America, Union League Club (Chicago), Niagara Club (Niagara Falls, N. Y.) and the Canadian Club of New York City.

Mr. Donald has been an outstanding leader in the movement to revitalize the trade and industry associations of America, as a practical mechanism for the co-ordination of industry under the recovery program. He has been selected to head the work of Nema because of his broad experience in code development during the past year and his fundamental knowledge in the mechanics of organized co-operation in business.

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John L. Neely, Jr., of Nashville, Tenn., has been appointed manager of Muscle Shoals properties by the T.V.A. Mr. Neely was formerly co-ordinator of T.V.A. and C.W.A. activities.

Harrison A. Smith has joined the Wisconsin Power & Light Company at Madison to engage in special work in connection with the development of the company's business. For the past two years he was manager of the eastern division of the company at Fond du Lac.

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D. D. Smalley Promoted to General Superintendency

Dunlap D. Smalley has been appointed general superintendent of the San Joaquin Light & Power Corporation and the Midland Counties Public Service Corporation, a San Joaquin subsidiary. Mr. Smalley first became affiliated with the San Joaquin properties in 1912, when he assumed supervisorial duties in the Merced and Los Banos districts of the San Joaquin company. In 1920 he was promoted to distribution superintendent of the Midland

Counties Public Service Corporation, the position he held until his recent promotion to general superintendent. Mr. Smalley spent one year in the laboratories of the Westinghouse Electric & Manufacturing Company following his graduation from the University of California. The position of general superintendent was made vacant through the resignation of E. A. Quinn, who relinquished these duties after twenty years of service.

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G. B. Fluehr Assumes New Executive Duties

George B. Fluehr has been named vice-president and general manager of the Illinois Northern Utilities Company, Dixon, in direct charge of all operations of the company. The elevation of Mr. Fluehr places him in the executive position held by the late E. D. Alexander, who was president and general manager. Mr. Fluehr started his career in the electrical industry with the companies that later con-

solidated to form the Illinois Northern Utilities Company.

After obtaining some experience in the field of telephony, he secured a position with the Amboy Light & Power Company in 1907. He had a taste of every phase of operation from constructing lines to running the power house, and from firing the boilers to keeping office records. When the company was combined with the Oregon Power Company he was placed in charge of the southern division with headquarters in Amboy. Upon the formation of the Illinois Northern Utilities Company, in 1912, Mr. Fluehr was assigned to Morrison, subsequently becoming district superintendent at Sterling. After serving in Sterling for six years, he was moved to Freeport in 1919. Four years ago he was elected vice-president of the company to succeed Mr. Alexander, who was at that time promoted to the presidency.

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James Conklin has been appointed lighting engineer of the Consumers Power Company at Battle Creek, Mich. He is succeeding R. C. Waterbury, who has been transferred to the Jackson general offices.

Granville H. Bourne has been appointed comptroller of the Commonwealth & Southern Corporation to succeed the late H. G. Kessler. He has been chief assistant to Mr. Kessler and in active charge of the department for several years because of Mr. Kessler's poor health. After ten years association with Hodenpyl, Walbridge & Company, New York, Mr. Bourne became assistant secretary and assistant treasurer of the Commonwealth Power, Railway &

Light Company. When that organization grew into the Commonwealth & Southern Corporation he devoted considerable time to corporate accounting, and four years ago assumed the duties of assistant comptroller.

E. A. Herr of Dayton, Ohio, has been named purchasing agent for Servel, Inc., Evansville, Ind. Mr. Herr has had extensive experience in the purchasing of refrigerator materials.

J. M. Bourus has been made general auditor of the San Diego Consolidated Gas & Electric Company and assistant treasurer of the company. Mr. Bourus became identified with the San Diego utility in 1918 in the accounting department, following eight years of service with the Oklahoma Gas & Electric Company. He became assistant auditor in the fall of 1927.

J. T. Woodward of New York has been elected president of the Community Power & Light Company to succeed David A. Belden of New York. Mr. Woodward has been a director of the company for several years. Mr. Belden will remain active in the organization in New York.

Dr. Arthur C. Willard has been elected president of the University of Illinois. He was formerly professor of heating and ventilating and acting dean of the institution's College of Engineering. For years Dr. Willard has been one of the country's leading authorities on heating and ventilating subjects. He has been consultant on research matters for the American Society of Heating and Ventilating Engineers.

Rudolf W. Staud, assistant to the president and sales promotion manager of the Benjamin Electric Manufacturing Company, Des Plaines, Ill., has been named chairman of the supplementary code authority of the porcelain enameling manufacturing industry. Mr. Staud has long been prominent in this branch of the electrical industry and is president of the Porcelain Enamel Institute. In addition to these activities he is chairman of the code committee of the industrial lighting subdivision and a member of the code committee of the floodlighting subdivision of N.E.M.A. and chairman of the publicity committee of the Illuminating Engineering Society.

Hugh H. Spencer has joined the engineering staff of the Raytheon Manufacturing Corporation, Newton, Mass. For the present he will specialize in problems of product development. The Raytheon corporation will shortly occupy new quarters at Waltham, Mass. Mr. Spencer was formerly protection engineer of the New England Power Engineering & Service Corporation, Boston, Mass. He was connected with the transmission engineering activities of the General Electric Company and later with the engineering firm of Jackson & Moreland of Boston. While associated with the New England Power system, he shared in the development of the Fifteen-Mile Falls 220-kv. installation and its protective features.

OBITUARY

John E. Frazen, formerly superintendent of the Bloomfield (N. J.) plant of the General Electric Company, died April 29, after two years' illness. He was born in Sweden 75 years ago and studied engineering there before coming to this country.

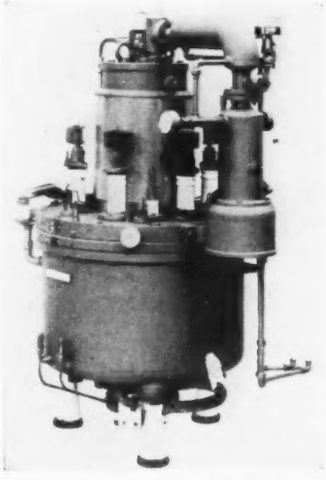
Edwin Lewis Crosby, founder and president of the Detroit Electric Furnace Company and widely known in the public utility and foundry industries, died May 5 in Ludlow, Mass., of injuries suffered in an automobile accident. Born in Plymouth, Michigan, 51 years ago, Mr. Crosby was educated in Plymouth schools. After graduation he entered the employ of the Semet Solvay Company, completed a course of study in electrical engineering and for several years had charge of electrical operations for that company. In 1905 he joined the staff of the Detroit Edison Company and for 13 years was chief power salesman. In 1918, he left the Edison Company to organize the Detroit Electric Furnace Company, serving as vice-president and general manager, until 1920, when he became president.

Prof. Cecil H. Peabody, renowned authority on thermodynamics and steam engineering, died at the Peter Bent Brigham Hospital Boston, May 4, after a short illness. Professor Peabody was connected for many years with the faculty of the Massachusetts Institute of Technology in the mechanical engineering and naval architecture departments. Early in his career he was assistant professor of mathematics at the Imperial Agricultural College, Sapporo, Japan. He became assistant professor of steam engineering at M.I.T., in 1883 and headed the naval architecture course from its inception in 1893 until his retirement in 1920. Professor Peabody was born at Burlington, Vt., in 1855.

NEW EQUIPMENT

Grid-Controlled Rectifiers Now Available Here

Completion and shipment of the first high-voltage grid-controlled mercury-arc rectifier built in the United States is announced by the Allis-Chalmers Manufacturing Company. About three dozen of



Allis-Chalmers

these rectifiers have already been manufactured by the Brown-Boveri Company in Europe. The rectifier is rated at 1,000 kw., 25,000-volt direct-current output. A feature of the apparatus is the employment of the rectifier grid as a means of short-circuit protection.

If a short circuit occurs on the output side of this type of rectifier all of the grids are immediately made strongly negative with respect to the mercury pool cathodes. This prevents the re-establishment of current flow from any anode after its potential has fallen to zero on the incoming alternating-current wave.

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Small Heaters and Control

Laboratory heaters and rheostats designed for distillation, extraction, evaporation and other laboratory uses have been introduced by the American Instrument Company, Inc., Washington, D. C. The heaters are available for either 110 or 220 volts in either 350 or 500-watt sizes. They are constructed so that a cone-shaped refractory directs the heat upward, focusing it at the center of the opening in the flush top. Nichrome heating elements lie in radial slots in the refractory and are easily removed for replacement in case of burnout. The units are 6½ in. high and 5½ in. in diameter at the flush top.

The rheostats are designed for the smooth control of current supplied to heaters, small motors and other laboratory devices and are available separate from the heaters. A heavy roller contact insures positive contact without wear on the winding. A well-ventilated winding permits a high resistance to be used, without danger of burning out when the contact is near the zero resistance point. Heaters are connected in series with the rheostat by plug-in connections.

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Full-bolted conductor connectors for outdoor power service have been announced by the General Electric Company, Schenectady. They are designed to save time and expense in making connections between conductors, or conductors and terminal parts. Line pres-

sure contact is obtained by means of a series of thread-like cuts on the serrated surface; they also serve to bite into the conductor and assure a tighter joint. Connectors are made of high conductivity copper alloy and have the same current carrying ratings as extra-heavy iron-pipe-size copper tubing of 98 per cent conductivity.

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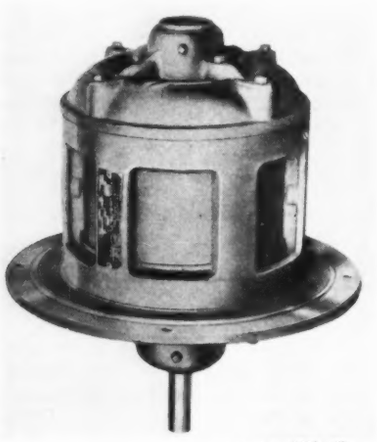
Flanged-Head Motors

Several types of flanged-head motor mountings have been announced by the Louis Allis Company, Milwaukee, Wis. Limitations in space for motor mounting on many applications such as machine



Louis Allis Co.

tools, including lathes, drills, grinders, polishers, etc., make it desirable to eliminate motor feet and provide a finished flange on motor head for end mounting. This type of motor is also used widely on close-coupled pump mountings. The flange illustrated is an integral part of the motor head and may be finished on either or both sides.

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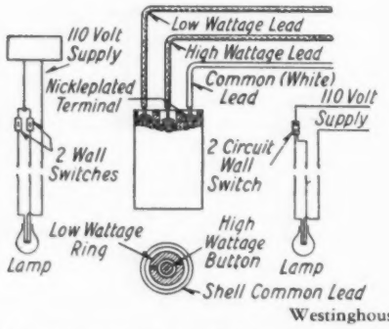
Three-Circuit Sockets

A new three-circuit lamp socket has been developed by the Westinghouse Electric & Manufacturing Company. It will be used in applications requiring two or three intensities from the same lighting unit, is especially adaptable



Westinghouse

with the new three-light lamps and where different levels of illumination are desirable, and is similar in outward appearance to the present mogul porcelain socket. The interior has been redesigned to provide a floating center contact, for the high-wattage lead, supported by a coiled steel spring which insures perfect contact. Surrounding this contact is a ring contact for the low-wattage lead and the standard shell provides the common lead.

The terminals on the back of the socket are arranged in deep cavities with large binding head screws to make wire connections. Polarity is denoted by the screw shell terminal being nickel plated. The supporting screw spacings are standard and it can therefore be substituted for the present mogul socket.

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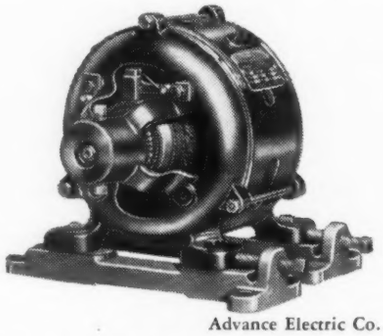
Repulsion-Capacitor Motor Has Improved Operation

Repulsion-capacitor motors in sizes from ½ to 5 hp. have been announced by the Advance Electric Company, 6301-17 Maple Avenue, St. Louis, Mo. Their operating speed is 1,250 r.p.m. from 220-volt, 60-cycle service. They are mechanically similar to the repulsion-starting induction motor utilizing the repulsion-starting rotor that automatically short circuits to produce a squirrel-cage effect at running speed. The capacitor and stator are designed for the best running condition, consequently there is no compromise in either stator or rotor to secure good starting characteristics. Efficiency is comparable to that of polyphase motors, so it is possible to utilize motor frames considerably smaller than in repulsion-induction motors and comparable with the polyphase. They are competitive in cost with the repulsion-induction motor and make the single-phase



Advance Electric Co.

motor mechanically interchangeable with the polyphase.

In camparison with the squirrel-cage high-starting torque capacitor motor, the repulsion has lower locked rotor current and higher locked rotor torque. It is not necessary to employ high flux densities or comparatively high rotor resistance with repulsion starting in order to provide high locked rotor torque. So both the power factor and efficiency under running conditions are better and a smaller and less expensive capacitor is required. No surge or overvoltage is imposed on the capacitor either during starting or running, as the small running capacitor is connected permanently in the capacitor phase. Capacitor failure is less likely, and even should it fail the motor will start and carry part load as a plain repulsion-induction motor. The capacitor is mounted externally and inclosed in a metal box for wall mounting.

ENGINEERING DATA FROM MANUFACTURERS

Bulletins and catalogs now available to engineers by manufacturers and associations

ELECTRIC WIRING FOR THE FARM, by F. B. Wright and B. B. Robb, Cornell Extension Bulletin No. 204, 122 pages. Available from R. H. Wheeler, New York State College of Agriculture, Cornell University, Ithaca, New York. Methods for application of electric light, power and heat to farm home and farmstead uses.

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FIRING METHOD MODERNIZED FOR PROFIT, Book No. 1419 of the Link-Belt Company, 2410 W. 18th St., Chicago. A comparison of hand firing and controlled automatic underfeed firing of boilers from 10 to 250 b.hp.; it illustrates smoke elimination, uniform temperatures and pressures, coal savings, firing efficiency, etc.

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CONSTRUCTION AND TEST OF SERVICE-ENTRANCE AND BRANCH-CIRCUIT BREAKERS, approved as Canadian standard by the Canadian Engineering Standards Association, 1934; C.E.S.A. Specification No. 5, 18 pages, March, 1934. Available from the association at Ottawa. Price 25 cents.

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CONSTRUCTION AND TEST OF FRACTIONAL-HORSEPOWER MOTORS, approved as Canadian standard by the Canadian Engineering Standards Association, 1934; C.E.S.A. Specification No. 11, 11 pages, March, 1934. Available from the association at Ottawa. Price 25 cents.

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U R C WEATHERPROOF WIRES AND CABLES, Bulletin B-KM-34.3 of the General Cable Corporation, 420 Lexington Ave., N. Y., 7 pages. Discusses the general problem of weatherproof wire defects and their causes, Purdue research on weatherproof saturants and cables under the Utility Research Commission, and the results of bend, melt and drip tests on URC wires and cables in comparison with other weatherproof types; the features of URC weatherproof are brought out.

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TURBINE WATER WHEELS, Bulletin 32 of the James Leffel & Co., Springfield, Ohio, 31 pages. Illustrates and briefly describes some of the many different types and designs of Leffel water turbines.

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ELECTRIC POWERED HYDRAULIC DREDGE, 8-inch pump size, for commercial sand production, Bulletin No. p7 of the American Manganese Steel Company, 7 pages, March, 1934. Complete description with drawings and illustrations of an AMSCO 8-inch pump dredge for the excavation of commercial sand aggregates, designed for sturdiest construction at minimum cost.

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TRENT ELECTRIC FURNACES of the pot and trough types, Leaflet TD-20 of the Harold E. Trent Company, 618-640 North 54th Street, Philadelphia, Pa., 4 pages. Discusses with illustrations and lists ratings, dimensions, capacities, etc. of the modified and redesigned Trent electric furnaces.